Gas Turbines & Controlled Cycle (BSC)

Course Outline with Outcomes

Content

1. Industrial Gas Turbines

Learning Outcome

Explain common designs, major and auxilliary components and operating principles of industrial gas turbines.

Learning Objectives

1. Explain how power is developed in a gas turbine.
2. Describe a typical energy profile through a simple gas turbine.
3. State the advantages and disadvantages of gas turbines.
4. Describe the designs and operation of the three main components of a gas turbine, the compressor, combustor and turbine.
5. Describe the auxiliary components and systems on a gas turbine.
6. Explain the control, monitoring and protection requirements for a gas turbine.
7. Describe the main steps in a typical gas turbine start-up sequence.

2. Gas Turbine Principles & Designs

Learning Outcome

Explain common designs, major components, operating principles, and arrangements for industrial gas turbines.

Learning Objectives

1. Explain gas turbine advantages and disadvantages, background and industrial applications. Identify the types of gas turbines, their major components and describe the operating principles of a simple gas turbine.
2. Explain single and dual shaft arrangements for gas turbines. Describe open cycle and closed cycle operation.
3. Describe a typical open cycle gas turbine installation, including buildings or enclosures, intake and exhaust systems, auxiliary systems, and reducing gear.
4. Explain the efficiency and rating of gas turbines and describe the purpose and applications of gas turbine cycle improvements, including intercooling, regenerating, reheating and combined cycle.
5. Describe various aspects of compressor design and centrifugal and axial types of compressors.
6. Describe the types, operation, components and arrangements of combustors.
7. Describe turbine section design and operation especially with respect to blading and materials.
8. Explain the types and functions of the control systems and instrumentation needed for gas turbine operation.
9. List the typical operating parameters of a gas turbine; describe the effects of compressor inlet temperature, compressor discharge pressure, and turbine inlet temperature on gas turbine performance.

3. Gas Turbine Design & Auxiliaries

Learning Outcome

Explain the design and components of a large gas turbine and related auxiliaries.

Learning Objectives

1. Explain applications and selection criteria for the different types of gas turbine engines.
2. Describe the principles and design of open and closed cycle gas turbine systems.
3. Describe the principles and design of combined cycle and cogeneration systems using gas turbines.
4. Describe the principles and design of gas turbine regeneration, intercooling, and reheating.
5. Describe the principles and design of gas turbine shaft arrangements.
6. Describe the design and components of gas turbine compressors, combustors (combustion chambers) and turbines.
7. Describe the design and operation of gas turbine air intake and exhaust systems.
8. Describe the design and operation of a gas turbine lubricating oil system.
9. Describe the design and operation of a gas turbine fuel system.
10. Describe the design and operation of a gas turbine steam or water injection system and a dry low NO_X system.

4. Gas Turbine Auxiliaries & Operation

Learning Outcome

Describe the support auxiliaries for a gas turbine and explain common operational, control and maintenance procedures.

Learning Objectives

1. Describe the types of bearings used in a gas turbine and explain the components, operation, protective devices and routine maintenance of a typical lube oil system.
2. Describe and explain the operation and routine maintenance of a typical fuel gas supply system for a gas turbine.
3. Describe and explain the operation and routine maintenance of a typical fuel oil supply system for a gas turbine.
4. Explain the control of NO_X from a gas turbine and describe the purpose and operation of water/steam injection and dry low NO_X systems.
5. Explain the purpose, location and operation of the gas turbine starting motor and turning gear.
6. Describe the compressor intake and the turbine exhaust components.
7. Describe the preparation and complete start-up sequence for a gas turbine.
8. Describe the shutdown sequence and procedure for a gas turbine.
9. Explain the purpose purpose and describe typical on-line and off-line waterwash procedures for gas turbine blades.

5. Introduction to Cogeneration

Learning Outcome

Explain cogeneration and describe common configurations, components and applications.

Learning Objectives

1. Define Cogeneration.
2. Describe two ways in which cogeneration can be achieved.
3. Explain the flows through a typical cogeneration system.
4. Explain the advantages of cogeneration.
5. State some common users of cogeneration.
6. Describe typical cogeneration installations using internal combustion engines and gas turbines.
7. Describe control of a cogeneration system.

6. Cogeneration Systems & Operations

Learning Outcome

Explain cogeneration and describe the common configurations, components and applications.

Learning Objectives

1. Define cogeneration and explain its purpose, advantages, and applications.
2. Explain the components and operation of simple-cycle cogeneration systems.
3. Explain the components and operation of combined-cycle, gas/steam turbine cogeneration systems.
4. Explain the components and operation of a fully fired, combined-cycle cogeneration system.
5. Explain single-shaft and dual-shaft combined-cycle power plants.
6. Explain the control strategies and components, for both power and steam production, including diverter and duct burner operation.
7. Describe the various designs of heat recovery steam generators (HRSGs) and explain their industrial applications.
8. Explain the environmental considerations and techniques in the operation of a cogeneration system.
9. Describe typical cogeneration systems that use internal combustion engines (gas or diesel) and heat recovery water heaters (HRWHs).
10. Explain a typical start-up procedure for a combined cycle cogeneration system.

7. Lubrication & Bearings

Learning Outcome

Explain the components of a lubrication application and maintenance program.

Learning Objectives

1. Explain the purposes of lubrication.
2. Describe the classes of lubricants and their appropriate uses.
3. Describe the properties of lubricating oils.
4. Explain the purposes of oil additives.
5. Explain boundary and fluid film lubrication as it applies to bearings.
6. Describe shell or sleeve bearings and explain their lubrication methods.
7. Describe ball and roller bearing designs and applications and explain their lubrication.
8. Explain symptoms of and reasons for bearing failure.
9. Sketch and describe a typical forced-feed lube oil skid.
10. Sketch and describe a simple lube oil system for a gas turbine.