





Chapter 10, Problem 22.

Consider a steam power plant that operates on a simple ideal Rankine cycle and has a net power output of 45MW. Steam enters the turbine at 7 MPa and 500°C and is cooled in the condenser at a pressure of 10 kPa by running cooling water from a lake through the tubes of the condenser at a rate of 2000 kg/s. Show the cycle on a T - s diagram with respect to saturation lines, and determine (a) the thermal efficiency of the cycle, (b) the mass flow rate of the steam, and (c) the temperature rise of the cooling water.

* Problems designated by a “C” are concept questions, and students are encouraged to answer them all. Problems designated by an “E” are in English units, and the SI users can ignore them. Problems with the  are solved using EES, and complete solutions together with parametric studies are included on the enclosed DVD. Problems with the  are comprehensive in nature and are intended to be solved with a computer, preferably using the EES software that accompanies this text.

Chapter 10, Problem 49.

A steam power plant operates on an ideal reheat– regenerative Rankine cycle and has a net power output of 80 MW. Steam enters the high-pressure turbine at 10 MPa and 550°C and leaves at 0.8 MPa. Some steam is extracted at this pressure to heat the feedwater in an open feedwater heater. The rest of the steam is reheated to 500°C and is expanded in the low-pressure turbine to the condenser pressure of 10 kPa. Show the cycle on a T - s diagram with respect to saturation lines, and determine (a) the mass flow rate of steam through the boiler and (b) the thermal efficiency of the cycle.

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Chapter 10, Problem 50.

Repeat Prob. 10–49, but replace the open feedwater heater with a closed feedwater heater. Assume that the feedwater leaves the heater at the condensation temperature of the extracted steam and that the extracted steam leaves the heater as a saturated liquid and is pumped to the line carrying the feedwater.

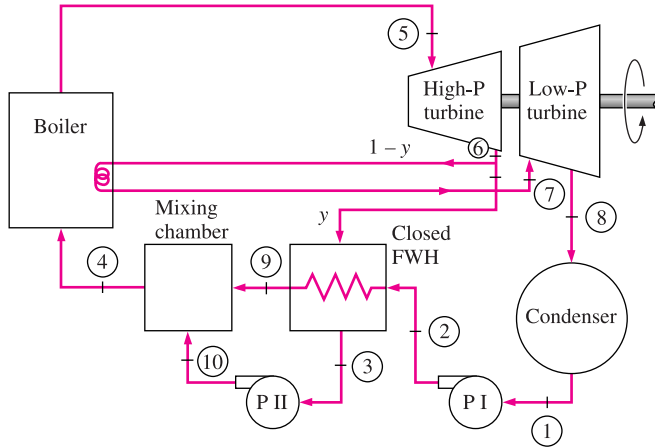




Figure P10-50

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Chapter 10, Problem 67.

Steam enters the turbine of a cogeneration plant at 7MPa and 500°C. One-fourth of the steam is extracted from the turbine at 600-kPa pressure for process heating. The remaining steam continues to expand to 10 kPa. The extracted steam is then condensed and mixed with feedwater at constant pressure and the mixture is pumped to the boiler pressure of 7 MPa. The mass flow rate of steam through the boiler is 30 kg/s. Disregarding any pressure drops and heat losses in the piping, and assuming the turbine and the pump to be isentropic, determine the net power produced and the utilization factor of the plant.

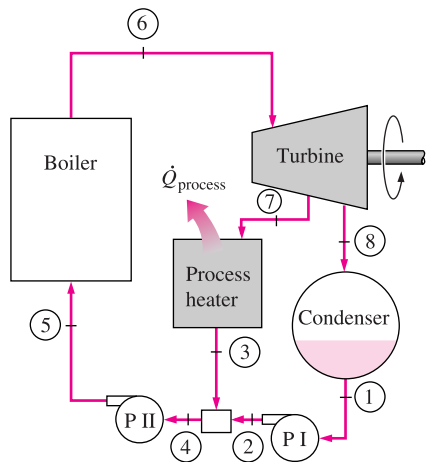


Figure P10-67

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Chapter 10, Problem 70.

Consider a cogeneration power plant modified with regeneration. Steam enters the turbine at 6 MPa and 450°C and expands to a pressure of 0.4 MPa. At this pressure, 60 percent of the steam is extracted from the turbine, and the remainder expands to 10 kPa. Part of the extracted steam is used to heat the feedwater in an open feedwater heater. The rest of the extracted steam is used for process heating and leaves the process heater as a saturated liquid at 0.4 MPa. It is subsequently mixed with the feedwater leaving the feedwater heater, and the mixture is pumped to the boiler pressure. Assuming the turbines and the pumps to be isentropic, show the cycle on a T - s diagram with respect to saturation lines, and determine the mass flow rate of steam through the boiler for a net power output of 15 MW.

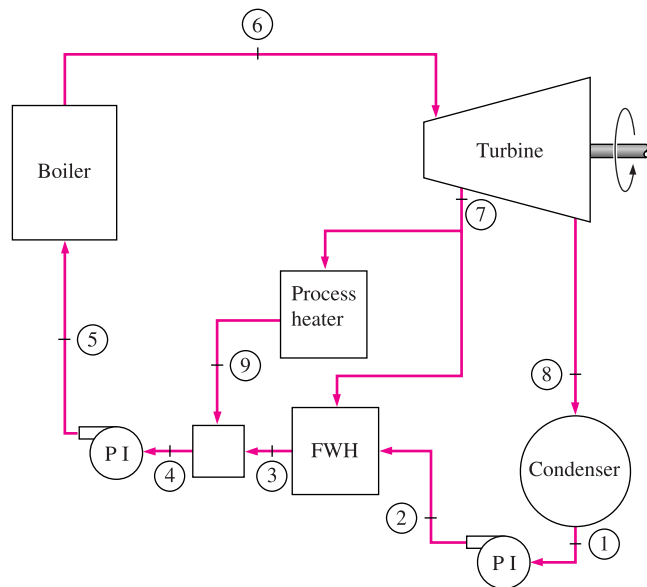




Figure P10-70

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Chapter 10, Problem 76.

The gas-turbine portion of a combined gas–steam power plant has a pressure ratio of 16. Air enters the compressor at 300 K at a rate of 14 kg/s and is heated to 1500 K in the combustion chamber. The combustion gases leaving the gas turbine are used to heat the steam to 400°C at 10 MPa in a heat exchanger. The combustion gases leave the heat exchanger at 420 K. The steam leaving the turbine is condensed at 15 kPa. Assuming all the compression and expansion processes to be isentropic, determine (a) the mass flow rate of the steam, (b) the net power output, and (c) the thermal efficiency of the combined cycle. For air, assume constant specific heats at room temperature.

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