A – Alvarado to Guler

ME 40 Spring 2020 Midterm 2

You are to evaluate a reheat Rankine cycle using water/steam.

Inlet pressure and temperature to the turbine are 12.5 MPa and 500 ℃.

Inlet pressure and quality to the pump is 10 kPa and x = 0.

The reheat from the high pressure to low pressure turbine is at 2 MPa to a maximum temperature of 400 ℃.

Condenser pressure is 10 kPa.

Pump efficiency (η_p) 85% (0.85).

You may make rough estimates of properties in the tables that need interpolation.

1. Calculate the thermal efficiency (η_{th}) for the actual cycle using pump efficiency (η_{pump}) = 0.85. You'll need to find the high-pressure turbine isentropic efficiency assuming the measured high-pressure turbine exit temperature (T_{actual}) and pressure, 300 ℃ and 2 MPa respectively. Assume a value for ($\eta_{Turbine}$) if you have trouble with the calculation or don't trust the result of your calculation.
2. Assuming that the steam can be treated as an ideal gas, find the high-pressure turbine isentropic exit temperature.
3. Using the high-pressure turbine inlet conditions and actual outlet conditions (300 ℃ and 2 MPa), find the polytropic exponent for the high-pressure turbine process.
4. Show, using calculations, whether the ideal gas assumption used for part 2 is reasonable.
5. Calculate work and heat transfer for the isentropic and actual pump processes.
6. Would it make sense to install an intercooling process for the pumping stage, why or why not? What are the benefits of intercooling in general?
7. It is proposed to raise the pressure in the condenser. Describe what effect this will have efficiency of the cycle and why. Are there any advantages?
8. Draw and label the components of the cycle and its path on the appropriate state diagrams.

B – Guo to Nash

ME 40 Spring 2020 Midterm 2

You are to evaluate a reheat Rankine cycle using water/steam.

Inlet pressure and temperature to the turbine are 8 MPa and 500 ℃.

Inlet pressure and quality to the pump is 1 MPa and x = 0.

The reheat from the high pressure to low pressure turbine is at 1.8 MPa to a maximum temperature of 500 ℃.

Pump efficiency (η_p) is 85% (0.85).

Condenser pressure is 100 kPa.

You may make rough estimates of properties in the tables that need interpolation.

1. Calculate the thermal efficiency (η_{th}) for the actual cycle using pump efficiency (η_{pump}) = 0.85. You'll need to find the high-pressure turbine isentropic efficiency assuming the measured high-pressure turbine exit temperature (T_{actual}) and pressure, 300 ℃ and 1.8 MPa respectively. Assume a value for ($\eta_{Turbine}$) if you have trouble with the calculation or don't trust the result of your calculation.
2. Assuming that the steam can be treated as an ideal gas, find the high-pressure turbine isentropic exit temperature.
3. Using the high-pressure turbine inlet conditions and actual outlet conditions, (300 ℃ and 1.8 MPa) find the polytropic exponent for the high-pressure turbine process.
4. Show, using calculations, whether the ideal gas assumption used for part 2 is reasonable.
5. Calculate work and heat transfer for the isentropic and actual pump processes.
6. Would it make sense to install an intercooling process for the pumping stage, why or why not? What are the benefits of intercooling in general?
7. It is proposed to lower the pressure in the condenser. Describe what effect this will have efficiency of the cycle and why. Are there any advantages? Are there any disadvantages?
8. Draw and label the components of the cycle and its path on the appropriate state diagrams.

C – Nassiri to Zinky

ME 40 Spring 2020 Midterm 2

You are to evaluate a reheat Rankine cycle using water/steam.

Inlet pressure and temperature to the turbine are 10 MPa and 450 ℃.

Inlet pressure and quality to the pump is 1 MPa and x = 0.

The reheat from the high pressure to low pressure turbine is at 2.5 MPa to a maximum temperature of 450 ℃.

Pump efficiency (η_p) is 85% (0.85).

Condenser pressure is 100 kPa.

You may make rough estimates of properties in the tables that need interpolation.

1. Calculate the thermal efficiency (η_{th}) for the actual cycle using pump efficiency (η_{pump}) = 0.85. You'll need to find the high-pressure turbine isentropic efficiency assuming the measured high-pressure turbine exit temperature (T_{actual}) and pressure, 300 ℃ and 2.5 MPa respectively. Assume a value for ($\eta_{Turbine}$) if you have trouble with the calculation or don't trust the result of your calculation.
2. Assuming that the steam can be treated as an ideal gas, find the high-pressure turbine isentropic exit temperature.
3. Using the high-pressure turbine inlet conditions and actual outlet conditions, 300 ℃ and 2.5 MPa, find the polytropic exponent for the high-pressure turbine process.
4. Show, using calculations, whether the ideal gas assumption used for part 2 is reasonable.
5. Calculate work and heat transfer for the isentropic and actual pump processes.
6. Would it make sense to install an intercooling process for the pumping stage, why or why not? What are the benefits of intercooling in general?
7. It is proposed to lower the pressure in the condenser. Describe what effect this will have efficiency of the cycle and why. Are there any advantages? Are there any disadvantages?
8. Draw and label the components of the cycle and its path on the appropriate state diagrams.