Energy Conservation and Waste Heat Recovery

1st Class Test

Time: 1 hour

Answer all the questions.

Q1. What is an endoreversible cycle? 2.5

Q2. Why SCR is used in a HRSG though its use for a standalone steam power plant is not common? 2.5

Q3. Draw the schematic diagram of a steam power plant and the T-s diagram of the corresponding cycle considering dual pressure steam generation in the HRSG. 10

Q4. A combined gas turbine-vapor power plant has a net power output of 10 MW. Air enters the compressor of the gas turbine at 100 kPa, 300 K, and is compressed to 1200 kPa. The conditions at the inlet to the turbine are 1200 kPa and 1400 K. Air expands through the turbine to a pressure of 100 kPa. The air then passes through the interconnecting heat exchanger, and is finally discharged at 480 K. Steam enters the turbine of the vapor power cycle at 8 MPa, 400°C, and expands to the condenser pressure of 8 kPa. Water enters the pump as saturated liquid at 8 kPa. Determine,

(a) the mass flow rates of air and water, each in kg/s.

(b) the rate of heat transfer to the combined cycle, in MW.

(c) the thermal efficiency of the combined cycle.

(d) From the given data, can you estimate a figure of merit for the above cycle based on second law? If yes, what is the value?

Condition of the environment: temperature =300 K, pressure = 100 kPa. Assume working fluid of gas turbine is air. $c_{p,\ air}$ = 1.007 kJ/kg.K. Heat addition may be idealized from a constant temperature source of 1600 K.

20