A simple steam power plant consists of four components, all operating at steady-state:   
(a) a feedpump, (b) a boiler, (c) a turbine, and (d) a condenser.   
 **State 1 🡪 2:** Saturated liquid water at 40 kPa enters the feedpump, is compressed isothermally, and exits at 10 MPa.   
**State 2 🡪 3:** Feedwater then enters the boiler and is heated isobarically to create high pressure steam at 700 °C.   
**State 3 🡪 4:** Next, the steam passes through a turbine and exits to a condenser at conditions of 40 kPa with 95% quality.   
**State 4 🡪 1:** Finally, heat is rejected isobarically by the condenser, generating saturated liquid that returns to the inlet of the feedpump.   
On a particular day, the mass flow rate through this steam plant is 100 kg/s.

### Part A – Hand Sketches and Planning

1. Make a diagram showing the four components and labeling States 1-4. Clearly identify which two independent, intensive properties are known at each state.
2. Simplify the general form of First Law of Thermodynamics for open systems for each component. Be careful/purposeful with your sign convention for Heat and Work.

### Part B – EES Properties and Solution

1. Using EES, solve for temperature, pressure, enthalpy, specific volume, and quality at each state. Place your values in an array table. Assign units in your array table so that no unit problems are detected.
2. Apply First Law of Thermodynamics to each component and have EES to solve for
   1. feedpump power [kW]
   2. rate of heat addition in the boiler [kW]
   3. turbine power [kW]
   4. rate of heat rejection from the condenser [kW]

Make each of these quantities a key variable. Make sure that no unit problems are detected in your solution window.

### Part C – Plotting and Report Windows

1. Overlay pressure and specific volume data from your array table on a P-v property plot. Select isotherms at 50 °C, 100 °C, 250 °C, and 700 °C. Show lines of constant quality. Use colored symbols to identify each of the state points. Do not connect state points with solid lines. Apply a label next to each state point on the property plot.

### Part D – Turn It In

1. A PDF printed from EES for Part B and C (equation window, solution window, array table, and property plot with overlaid data).