



APPLIED THERMODYNAMICS

TUTORIAL 2

Dated 10.8.2016

Time: 50 Mins

Q. 1 An exercise room has 6 weight-lifting machines that have no motors and 7 treadmills each equipped with a 2.5-hp (shaft output) motor. The motors operate at an average load factor of 0.7, at which their efficiency is 0.77. During peak evening hours, twelve (12) pieces of exercising equipment are used continuously from total, and there are also two people doing light exercises while waiting in line for one piece of the equipment. Assuming the average rate of heat dissipation from people in an exercise room is 600 W, determine the rate of heat gain of the exercise room from people and the equipment at peak load conditions.

Q. 2 A simple ideal Rankine cycle with water as the working fluid operates between the pressure limits of 17.5 Mpa in the boiler and 30 kPa in the condenser. What is the minimum temperature required at the turbine inlet such that the quality of the steam leaving the turbine is not below 80 percent. When operated at this temperature, what is the thermal efficiency of this cycle?

Q. 3 A simple Rankine cycle uses water as the working fluid. The boiler operates at 6000 kPa and the condenser at 50 kPa. At the entrance to the turbine, the temperature is 450°C. The isentropic efficiency of the turbine is 94 percent, pressure and pump losses are negligible, and the water leaving the condenser is subcooled by 6.3°C. The boiler is sized for a mass flow rate of 20 kg/s. Determine the rate at which heat is added in the boiler, the power required to operate the pumps, the net power produced by the cycle, and the thermal efficiency.

Q.4 BITS student living in a 3-m × 4-m × 4-m dormitory room turns on her 100-W fan before he/she leaves the room on a summer day, hoping that the room will be cooler when he/she comes back in the evening. Assuming all the doors and windows are tightly closed and disregarding any heat transfer through the walls and the windows, determine the temperature in the room when she comes back 8 h later. Use specific heat values at room temperature, and assume the room to be at 100 kPa and 20°C in the morning when he/she leaves.

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