Assuit University
Mechanical Eng. Dept.
Final Term Exam

Thermal Machines

Time allowed (1.5 hours)

Faculty of Engineering
2nd Year Electrical
Second Term 2014/2015

Answer all questions and assume any missing data
Steam Tables are allowed from Vice Dean office
Total points (50 points)

Q1. a. (5 Points) Prove that for isentropic process of an ideal gas

$$Pv^k = c$$

b. .(8 Points) Heat engine receives 1 MW from reservoir at 700°C and it rejects 400 KW heat to reservoir at 40°C. Find the heat engine thermal efficiency. Assume the same heat transfer to the heat engine and same reservoirs temperatures, what is the maximum power output could be produced from the heat engine and its thermal efficiency.

Q2.(16 points) A cylinder fitted with a piston contains steam at 300°C, 2 MPa, at which point the cylinder volume is 100 liters. The steam now expands reversibly doing work against the piston, until the final pressure is 300 kPa. How much work does the steam during this process and heat transfer if the process is (a) adiabatic (b) polytropic ($Pv^{0.9} = c$).

Q3. (16 points) Consider a regenerative cycle in an ideal steam power planet utilizing steam as the working fluid. Steam leaves the boiler and enters the turbine at 4 MPa, 400°C. After expansion to 400 kPa, 10 kg/s of the steam is extracted from the high pressure turbine turbine for heating the feedwater in an open feedwater heater. The pressure in the feedwater heater is 400 kPa and the water leaving it is saturated liquid at 400 kPa. The steam not extracted expands to 10 kPa in the low pressure turbine. Determine: (a) The mass flow rate of steam leaving the boiler (b) the net power output from the power planet (c) the cycle thermal efficiency.

Q4. (8 points) A composite wall is formed of a 2.5-cm copper plate (k=385 W/m °C), a 3.2-mm layer of asbestos (k=0.15 W/m °C), and a 5-cm layer of fiberglass (k=0.04 W/m °C). The wall is subjected to an overall temperature difference of 560°C. Calculate the heat flow per unit area through the composite structure

End of Questions
Dr. Hamdy AboAli