Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 level 2nd Semester Examination – Dec. /Jan. 2016/17
SCT 368-1 Applied Thermodynamic

Uva Wellassa University

Instructions to candidates
Duration: One (01) hours
Number of questions: Three (03) Essays
Mark allocation: 100
Answer two (02) questions only
Use thermodynamic property tables if needed

1.

a. State the Kelvin – Planck Statement related to the second law of thermodynamics by giving one practical example (Maximum 100 words) (6 marks)

b. The compression ratio of an air-standard Otto cycle is 9.5. Prior to the isentropic compression process, the pressure, temperature and volume of air is 100 kPa, 32°C, and 600 cm^3 respectively. The temperature at the end of the isentropic expansion process is 800 K. Using specific heat value at room temperature as R = 0.287 KPa.m^3/kg.K, and determine the following by showing the cycle in P-V and T-S diagrams.

i. The highest temperature and pressure in the cycle.
(8 marks)

ii. The amount of heat transferred in heat addition process, in kJ.
(2 marks)

iii. The thermal efficiency.
(4 marks)

iv. The mean effective pressure.
(5 marks)

2. Norochcholai coal power plant is the very first coal power plant in Sri Lanka which produces 900 MW of electric power. It has three turbines where each produces 300MW of electric power. Assume that the power plant operates on an ideal Rankine cycle with turbine inlet conditions of 5 MPa and 450 °C and a condenser pressure of 25 kPa. The coal has a heating value (energy released when the fuel is burned) of 29,300 kJ/kg. Assume that 75 percent of this energy is transferred to the steam in the boiler and that the electric generator has an efficiency of 96 percent. Determine.

a. The quality of the steam at the turbine exit.
(8 marks)

(12)

b. The mechanical output of the turbine.

(7 marks)

c. The overall plant efficiency. (the ratio of net electric power output to the energy input as fuel) (7 marks)

d. The required rate of coal supply for one turbine to produce 300MW of power.

(3marks)

3.

a. Describe the difference between heat pump and refrigerator (Maximum 100 words)

(5 marks)

b. A refrigerator uses refrigerant-134a as the working fluid and operates on an ideal vapor-compression refrigeration cycle between 0.14 and 0.8 MPa. If the mass flow rate of the refrigerant is 0.05 kg/s, determine

i. The rate of heat removal from the refrigerated space and the power input to the compressor (10 marks)

ii. The rate of heat rejection to the environment, and the COP(coeficient of performance) of the refrigerator

(5 marks)

iii. If the same arrangement is used as a heat pump, calculate the COP of the heat pump (5 marks)