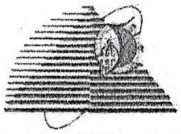
Fayoum University
Faculty of Engineering
Dept. Of Electrical Engineering
First year



Final Exam of (Thermodynamic)

First Semester
Date: 26/1/2016
Time : 3 Hours
Full mark: 85

Answer all the following Questions (allowable charts and table)

assume any missing data for air take c_p=1.005J/kg K and c_v= 0.718 kJ/kg K.

Question 1 (20 marks)

a) A Steam at 5 MPa and 400°C enters a nozzle steadily with a velocity of 80 m/s, and it leaves at 2 MPa and 300°C. The inlet area of the nozzle is 50 cm2, and heat is being lost at a rate of 120 kJ/s. Determine (a) the mass flow rate of the steam, (b) the exit velocity of the steam, and (c) the exit area of the nozzle.

b) An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar, find the following :

(i)The air standard efficiency of the cycle.
(ii)The mean effective pressure for the cycle.
(iii) temperature and pressure at each point.

Question 2(20 marks)

a) Consider an air standard cycle in which the air enters the compressor at 1.0 bar and 20°C. The pressure of air leaving the compressor is 3.5 bar and the temperature at turbine inlet is 600°C. Determine per kg of air :

(i) Efficiency of the cycle, (ii) Heat supplied to air,
(iii) Work available at the shaft, (iv) Heat rejected in the cooler, and
(v) Temperature of air leaving the turbine.

b) A heat engine is supplied heat at the rate of 1700 kJ/min and gives an output of 9 kW. Determine the thermal efficiency and the rate of heat rejection.

Question 3 (15 marks)

Consider a two-stage cascade refrigeration system operating between the pressure limits of 1.5 MPa and 100 kPa with refrigerant-134a as the working fluid. Heat rejection from the lower cycle to the upper cycle takes place in an adiabatic counter-flow heat exchanger where the pressure in the upper and lower cycles are 0.4 and 0.5 MPa, respectively. In both cycles, the refrigerant is a saturated liquid at the condenser exit and a saturated vapor at the compressor inlet. If the mass flow rate of the refrigerant through the lower cycle is 0.15 kg/s, determine (a) the mass flow rate of the refrigerant through the upper cycle, (b) the rate of heat removal from the refrigerated space, and (c) the C.O.P of this refrigerator?

Question 4 (15 marks)

The gas-turbine portion of a combined gas–steam power plant has a pressure ratio of 16. Air enters the compressor at 300 K at a rate of 14 kg/s and is heated to 1500 K in the

combustion chamber. The combustion gases leaving the gas turbine are used to heat the steam to 400°C at 10MPa in a heat exchanger. The combustion gases leave the heat exchanger at 420 K. The steam leaving the turbine is condensed at 15 kPa. Assuming all the compression and expansion processes to be isentropic, determine (a) the mass flow rate of the steam, (b) the net power output, and (c) the thermal efficiency of the combined cycle?

Question 5 (15 mark)

Choose the Correct Answer :

1- In isothermal process

(a) temperature increases gradually (b) pressure remains constant

(c) enthalpy change is maximum (d) change in internal energy is zero

2- The processes or systems that do not involve heat are called

(a) isothermal processes (b) equilibrium processes

(c) steady processes (d) adiabatic processes.

3- A definite area or space where some thermodynamic process takes place is known as

(a) thermodynamic system (b) thermodynamic cycle

(c) thermodynamic process (d) thermodynamic law.

4-….. cycle comprises of two isentropic processes and two constant pressure processes

(a) Rankine (b) Otto

(c) Carnot (d) diesel

5- In a regenerative feed heating cycle, the optimum value of the fraction of steam extracted for feed heating…….

(a) decreases with increase in Rankine cycle efficiency

(b) increases with increase in Rankine cycle efficiency

(c) is unaffected by increase in Rankine cycle efficiency

(d) none of the above

6- Second law of thermodynamics defines

(a) heat and work (b) enthalpy

(c) entropy (d) internal energy.

7- If all the variables of a stream are independent of time it is said to be in……..

(a) uniform flow (b) unsteady flow

(c) steady flow (d) closed flow

8- The maximum efficiency of an ideal Carnot engine occurs when……

(a) minimum temperature of the sink only (b) maximum temperature of the source only

(c) absolute temperature (d) maxi. temperatures of the source and mini. of the sink

Good Luck