Mansoura University		Mechanical Power Department Total Marks 100	Faculty of Engineering
Course Title: Thermodynamics I			Course Code: MPE4114
Date: June 2014 (First Term) نهاية الفصل		Allowed Time 3 hours	No of Pages: 1
Thermodynamic tables are allowed – **Give units of ALL deduced quantities**			

Question No. (1)   (25 Marks)

A rigid tank of volume 17.15 liter contains 0.5 kg of steam initially at 200°C. Heat from a reservoir at 500°C is added to steam until its pressure reaches 80 bar. Find final steam temperature, heat and work exchanged by steam, steam entropy change, entropy production of Universe and availability loss.

Question No. (2)   (20 Marks)

In an insulated air compressor, air is admitted at ambient conditions (1 bar, 27°C). If the mass flow rate was 2kg/s, final pressure was 75.9 bar and isentropic efficiency was 75%, find exit temperature as well as heat and work exchanged by air. Find also total entropy production as well as Second law efficiency. Assume air is a semi-ideal gas.

Question No. (3)   (15 Marks)

It is required to heat a room by adding 2kW at 29°C, while outside temperature is 5°C. Heat will be provided for 1000 hours per year over 2 years. Two options are available. The first option is to buy an electric heater of price 150 EGP. The second option is to buy an air conditioning system of price 2 000 EGP. The system can be considered as a heat pump having a COP that is 40% that of a Carnot engine working at the same temperatures. Knowing that the price of a kWh is 0.6 EGP, calculate the sum of initial and running costs (تكلفة الشراء زائد تكلفة التشغيل) of both options over the two years. Which is cheaper?

Question No. (4)   (20 Marks)

A rigid insulated tank is internally separated into two rooms by a membrane. Room A has a volume of 0.2 m^3, containing 0.3 kg of N_2 initially at 1.5 bar. Room B has a volume of 0.6 m^3, containing 0.1 kg of H_2 initially at 2.5 bar. Membrane ruptures, gases mix. Find mixture pressure and temperature, partial pressures of each gas in the mixture as well as entropy production due to this process.

Question No. (5)   (20 Marks)

A rigid tank of volume 0.2 m^3 initially contains oxygen at ambient conditions (1 bar, 27°C). Tank is filled by connecting it to a line where oxygen flows at 4 bar and 350K, until pressure in the tank reaches 2bar. Heat exchanged during this rapid process can be neglected. Find final temperature and mass within the tank.

Best Wishes – Prof. Mohamed-Nabil Sabry