Higher Institute for Engineering and Technology, El-Manzala
Electronics Engineering Department

Course Title: Thermodynamics and Heat Transfer	**Semester:** Second
Code: MEC121	**Level:** First
Course Coordinator: Dr. Sherihan Abdel-Ghafour	**Academic Year**: 2022-2023

Sheet (2)

First Law of Thermodynamics

1) The internal energy of a system increases by 210 kJ, while the system receives 167 kJ of work. **Find** the quantity and direction of heat transfer. Neglect kinetic and potential energies. **(Ans. +43 kJ)**

2) A closed system having a mass of 40 kg has initial velocity of 12 m/s. Its velocity is increased to 31 m/s and its elevation is increased by 43 m. During this process, the system receives 25,000J of heat and 4,800 J of work. The system delivers 0.002 kWh of electrical energy. **Calculate** the change in internal energy of the system. **(Ans. 10.61 kJ)**

3) Air enters a nozzle with a velocity of 50 m/s. The decrease in enthalpy in the nozzle is 180 kJ/kg. **Determine** the velocity and the kinetic energy of air at exit. **(Ans. 602 m/s, 181.2 kJ/kg)**

4) An oil pump is used to deliver a constant mass flow of 20 kg/min of oil to a specific machine. If the power required for this pump is about 100 W. **Estimate** the head delivered by this pump. **(Ans. 30.58 m)**

5) The mass flow rate of gas in a turbine is 40 kg/s. The enthalpy of the gas is 1,050 kJ/kg at inlet and 636 kJ/kg at exit. If the turbine is well insulated and the changes in kinetic and potential energies are negligible, **Calculate** the work in kJ/kg of gas, and also the power developed in kW. **(Ans. 414 kJ/kg and 16,560 MW)**

6) Boiler having a capacity of 10 kg/s is used to produce a steam at 50 bar and 300˚C (enthalpy of 2,927 kJ/kg). The natural gas with heating value of 45,000 kJ/kg is used as a fuel for this boiler. **Specify** the fuel mass flow rate if the water enters the boiler at 52 bar and 40˚C (enthalpy of 172 kJ/kg). **(Ans. 0.612 kg/s)**

7) Steam enters a condenser with an enthalpy of 2,300. At the exit, the condensate has an enthalpy of 188 kJ/kg. The cooling water enthalpy increases by 25 kJ/kg. **How many** kilograms of cooling water are needed to condense 1 kg of steam? **(Ans. 84.48 kg/s)**