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جامعة الأسكندرية
كلية الهندسة
قسم الهندسة البحرية و عمارة السفن

3rd year – Marine Power Plants
Gas turbines

1. A gas turbine unit has the pressure ratio 10 /1 and the maximum cycle temperature 700ºC. The isentropic efficiencies of the compressor and turbine are 0.82 and 0.85 respectively. Calculate the power output of an electric generator geared to the turbine, when the air enters the compressor at 15 ºC at the rate of 15 kg / sec. Take C_p= 1.005 kJ/kg K and γ = 1.4 for the compression process, and take C_p = 1.11 kJ / kg K and γ = 1.333 for the expansion process.

2. A gas turbine unit takes air at 17 ºC and 1.01 bar and the pressure ratio is 8 /1. The compressor is driven by HP turbine and the LP turbine drives a separate power shaft. The isentropic efficiencies of the compressor and the HP and LP turbines are 0.8, 0.85, and 0.83 respectively. Calculate the pressure and the temperature of the gases entering the power turbine, the net power developed by the unit per kg / sec mass flow rate, the work ratio and the cycle efficiency of the unit. The maximum cycle temperature is 650 ºC. For the compressor process take C_p = 1.005 kJ / kg K and γ = 1.4, for the combustion process, and for the expansion process take C_p = 1.15 kJ / kg K and γ = 1.333. Neglect the mass of fuel.

3. In a constant pressure gas turbine, air enters the compressor at 1.02 bar and 27ºC. The pressure of the air after compression is 4.08 bar. The isentropic efficiencies of the compressor and turbine are 80 % and 85 % respectively. The A:F ratio is 80 : 1. Find the developed power and thermal efficiency of the cycle if the flow rate of air is 2.5 kg / sec. Take C_p = 1 kJ/kg K and γ = 1.4 for air and gases. C.V. of fuel used = 41720 kJ / kg.

4. Air enters at 1 bar and 15ºC into the compressor of a constant pressure open cycle gas turbine plant and leaves the compressor at 6 bar. Using the following data: Temperature of the gas entering the turbine = 700 ºC, pressure loss in the combustion chamber = 0.1 bar. η_C = 80 % and η_T = 80 %, and $\eta_{Comb.}$ (combustion) = 90 %. Take C_p = 1.0 kJ / kg K and γ = 1.4 for air and gases and CV=43000 kJ/kg. Find: (i) The quantity of air circulation in the system if the plant develops 5 MW, (ii) the specific fuel consumption, (iii) The thermal efficiency and (iv) the exhaust temperature. Neglect the mass of fuel.