Gas Turbine	a) Simple Brayton Cycle b) Simple Actual Brayton Cycle c) Actual Brayton Cycle with Reheater	2 problems Apply and analyze in both problems

1. In gas turbine plant air at 10°C and 1.01 bar is compressed through a pressure ratio of 4.1. In a heat exchanger and combustion chamber the air is heated to 700°C while its pressure drops to 0.14 bar. After expansion through the turbine, the air passes through a heat exchanger which cools the air through 75% of the maximum range possible while the pressure drops 0.14 bar, and the air is finally exhausted to the atmosphere. The isentropic efficiency of the compressor if 0.80, and that of the turbine is 0.85. Assuming that the mass flow rate of air is equal to the mass flow rate of the exhaust gases and the specific heats are constant throughout the cycle find:

a) actual temperature at the exit of the compressor in Kelvin
b) actual temperature at the exit of the turbine in kelvin
c) work net of the cycle in Kj/kg
d) heat added in the combustion chamber in Kj/kg
e) thermal efficiency of the cycle

Ideal Brayton Cycle Sample Problems

1. The pressure ratio of an air standard Brayton cycle is 4.5 and the inlet conditions to the compressor are 100 kPa and 27℃. The turbine is limited to a temperature of 827℃ and mass flow is 5 kg/s. Determine

a) the thermal efficiency

b) the net power output in kW

c) the BWR

2. A gas turbine power plant operating on an ideal Brayton cycle has a pressure ratio of 8. The gas temperature is 300 K at the compressor inlet and 1300 K at the turbine inlet. Utilizing the air-standard assumptions, determine (a) the gas temperature at the exits of the compressor and the turbine, (b) the back work ratio, and (c) the thermal efficiency.

Sample Problems on Deviation of Actual Gas-Turbine Cycles from Idealized Ones.

1. A gas turbine power plant operating on an ideal Brayton cycle has a pressure ratio of 8. The gas temperature is 300 K at the compressor inlet and 1300 K at the turbine inlet. Utilizing the air- standard assumptions. Assuming a compressor efficiency of 80% and a turbine efficiency of 85 % determine (a) the back work ratio, (b) the thermal efficiency, and (c) the turbine exit temperature.

2. In a constant pressure open cycle gas turbine, air enters at 1 bar and 20°C and leaves the compressor at 5 bar. Using the following data; Temperature of gases entering the turbine = 680°C, pressure loss in the combustion chamber = 0.1 bar, $\eta_{compressor}$ = 85%, $\eta_{turbine}$ = 80%, $\eta_{combustion}$ = 85%, k = 1.4 and cp = 1.024 kJ/kg-K for air and gases, find:

a. The quantity of air circulation if the plant develops 1065 kW.

b. Heat supplied per kg of air circulation

c. The thermal efficiency of the cycle

1. Air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature of 200C. the pressure of the air after compression is 4 bar, the isentropic efficiencies of the compressor and turbine are 80% and 85%, respectively, and the air-fuel ratio used is 90:1 if the flow rate of air is 3.0kg/s find (a) the power developed (b) the thermal efficiency of the cycle, (assume Cp =1.0 KJ/kg and k = 1.4 of air and gases calorific value of fuel = 41800KJ/Kg.

2. In an open cycle regenerative gas turbine plant, the air enters the compressor at 1 bar 32°C and leaves at 6.9 bar. The temperature at the end of the combustion chamber is 816°C. The isentropic efficiencies of the compressor and turbine are 0.84 and 0.85, respectively. Combustion efficiency is 90% and the regenerator effectiveness is 60 percent, determine the (a) thermal efficiency, (b) air rate, (c) work ratio, and (d) back work ratio.