1. A Brayton cycle operates ideally from the ambient air at 300 K and 1 bar. The max pressure is 11 bar. Max allowable temperature is 1200K. Draw the ideal cycle for this engine in TS and PV diagrams and mark the states. Find the individual states (P, T, v) in this cycle. Find the overall work output per mass of air used. Also find the efficiency.

2. Given that the Brayton cycle can operate between a T_{max} and a T_{min} only, <u>Find</u> the Max pressure ratio $r_{P,max}$ at which the cycle can operate. <u>Find</u> an expression for W_{net}/m in terms of r_P. Find the optimum r_P for W_{max}/m and the W_{max}/m for these given limits on Temperatures. What is the efficiency at the $r_{P,opt}$? What is the optimum r_P for the current day limits of T_{min}=220 K and T_{max}=1600K? What is the efficiency then? Compare this with the Carnot efficiency.

3. A Land based Gas turbine is used as a power plant, which takes in air at 1 atm and 283K. Its allowable maximum temperature is 750 deg C. Its pressure ratio is 5.5. The isentropic efficiency of the compressor is 0.82 and that of the turbine is 0.85. A regenerator is fitted between the compressor outlet and the burner inlet in order to conserve some heat from the exhaust gases. The efficiency of the regenerator is 0.7. Find (a) the overall efficiency of the cycle, (b) The work per kg mass of air from the turbine, (c) Find the fuel-air ratio of the burner if the calorific value of the fuel used is 45.2 MJ/kg.

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Problems to be solved in class

1. A gas turbine engine is modified to use a regenerator which has an efficiency of 0.75. Air at inlet is at 1 bar and 373 K. Pressure in the burner is 6 bar. Maximum temperature allowed in this cycle is 1173 K. Assume the isentropic efficiency of the compressor and turbine are 0.8. Regenerator uses the exhaust gases to heat the compressed gases to a higher temperature before adding heat using fuel. Find the cycle efficiency before and after fitting the regenerator to this engine.