Semester Design Project #1 Thermodynamics II MECE 3336 Fall 2017

Due Date: Thursday, February 23th, 2017 at 5:50pm

Project Description: The first group (3-4 students) design project is the design, modeling, and optimization (thermal efficiency) of a steam power plant. The power plant must incorporate regeneration and reheat to improve efficiency and have a minimum of **ten components**. The objective of the project is to document the design and optimization of an efficient and practical steam power plant. The design optimization will be facilitated with the use of a computer model (Excel1) that calculates the efficiency and power output of the plant given equipment layout and operating conditions (flow rates, temperatures, and pressures). The computer model is based on an Ideal Rankine cycle with a **mass flow rate of 100 kg/s**. The maximum pressure and temperature must be less than or equal to **16 MPa and 700 ºC** respectively. The minimum condenser pressure must be greater than or equal to **0.08 bar**. The turbine exit quality must not be lower than **90%.** The Excel model will also calculate thermodynamic properties (T,P,h,v, and s) at each state in the cycle. The project is worth 8% of your final grade.

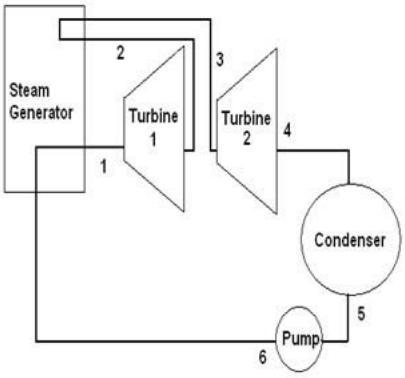
The results must be presented in a three page report that clearly explains the project objective, the power plant design (schematic and T-s diagram), optimization process (data, graphs, and conclusions for three variables), and final results (efficiency and power produced). Your report must include an appendix that contains **(1)** a printed copy of your Excel program (send electronic version via email), **(2)** hand calculations for a set of operating conditions verifying the program results, **(3)** hand calculations for the optimal design verifying the maximum efficiency, and **(4)** tables and plots showing eight data points for each of the three optimized variables.

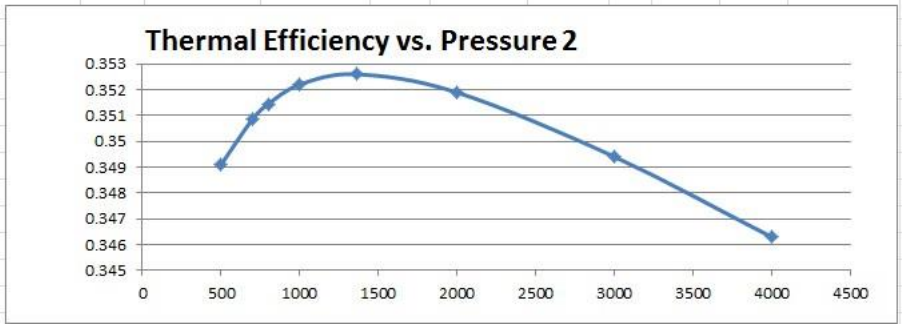
Example Output: The reheat pressure was optimized to provide maximum efficiency in the example below. Show optimization for three variables (in sequence) in your model and present your optimization results in your report in graphs and tables as shown below.

State	Given			Find		
#1	T=	480.000	C	H=	3347.815	kJ/kg
	P=	8000.000	kPa	S=	6.658	kJ/kg-K
#2s	P=	1380.000	kPa	H=	2878.273	kJ/kg
	S=	6.658	kJ/kg-K			
#2	P=	1380.000	kPa	H=	2948.705	kJ/kg
	eff=	0.850				
#3	T=	440.000	C	H=	3343.599	kJ/kg
	P=	1380.000	kPa	S=	7.433	kJ/kg-K
#4s	P=	8.000	kPa	H=	2326.491	kJ/kg
	S=	7.433	kJ/kg-K			
#4	P=	8.000	kPa	H=	2479.057	kJ/kg
	eff=	0.850				
#5	P=	8.000	kPa	H=	173.632	kJ/kg
				V=	0.001	m^3/kg
#6	P=	8000.000	kPa	H=	181.692	kJ/kg

mdot=	100	kg/s
Wt1=	39.911	MW
Wt2=	86.454	MW
Wp=	0.806	MW
Qin1=	316.61	MW
Qin2=	39.489	MW
Eff=	0.3526	

P2 (kPa)	Eff	Power (MW)
4000	0.3463	114.32
3000	0.3494	118.14
2000	0.3519	122.49
1360	0.3526	125.67
1000	0.3522	127.62
800	0.3514	128.76
700	0.3509	129.35
500	0.3491	130.64





Grading Form Semester Design Project #1 Thermodynamics II MECE 3336 Fall 2017

Date and Time Submitted _____ (10 points/day if late)

Group Members

1. _____
2. _____
3. _____
4. _____

(____/40 pts) Three page report (5 points each). Departmental Learning Objectives for the Course

By the conclusion of this course, competent students will have demonstrated the ability to design and analyze components and systems for mechanical and energy performance.

- Objective
- Description of Design
- Rationale of Design
- Schematic
- T-s diagram
- Optimization Methodology
- Optimization Results
- Conclusions

(____/40 pts) Appendix (5 points each or as noted)

- Printed copy of Excel program
- Hand calculations for an initial set of operating conditions
- Hand calculations for the optimal design
- (10 pts) Eight values for three variables
- Spreadsheet results for optimal efficiency of each variable
- (10 pts) Graph of efficiency and power for each variable

(____/20 pts) Electronic copy of Excel program (5 points each or as noted)

- Format
- (10 pts) Accuracy
- Detailed
- (Optional) Dynamic T-S Diagram

Total =_____/100 pts