**ME 433 Week #2 STUDY GUIDE**

**SI Engines – Study Questions**

1) What processes occur during each of the four strokes in a 4-stroke SI engine?
2) What terms in the 1st law of thermodynamics are active for each of the four strokes?
3) How do you find the top dead center volume (clearance volume) from the cylinder displacement and compression ratio?
4) What do IVO, EVC, IVC, EVO mean in the pressure versus crankangle diagram for a four stroke SI engine? Why do these occur at their respective locations?
5) At what location does maximum cylinder pressure occur in a SI engine? Why is this not at TDC?
6) Why is scavenging especially important in a 2-stroke engine? What are common methods of scavenging?
7) What do IPO, EPC, IPC, EVC mean in the pressure versus crankangle diagram for a two stroke engine? Why do these occur at their respective locations?
8) How is load controlled in a SI engine?
9) What is the difference between a carburetion system and a fuel injection system for delivering fuel to a SI engine? Which is more common in modern automobile engines? Why? Which is more common in small utility engines? Why?
10) How is engine performance impacted through use of a supercharger?
11) What is the difference between a supercharger and a turbocharger?
12) What is the purpose of an intercooler? Why does this enhance engine performance?
13) What is turbo lag? Why does this occur?
14) What is the purpose of a wastegate? At what load level is a wastegate deployed? Why?

**CI Engines – Study Questions**

1) What processes occur during each of the four strokes in a 4-stroke CI engine?
2) What do SOI, EOI, EOC, and SOC mean in the pressure versus crankangle diagram for a four stroke CI engine?
3) At what location does maximum cylinder pressure occur in a CI engine? Why is this not at TDC?
4) What is the difference between CI and SI fuel injectors?
5) Is there such a thing as a 2-stroke CI engine?
6) How is load controlled in a CI engine?

**Otto Cycle Modeling – Study Questions**

1) What assumptions underlie the air standard analysis?
2) In what ways is the Otto cycle a simplification of a Real cycle?
3) What is the direction of change in temperature, entropy, pressure, and volume during each of the processes that make up an Otto Cycle?
4) What does an Otto Cycle look like on a PV diagram?
5) What does an Otto Cycle look like on a TS diagram?
6) What is the name of the thermodynamic process for each stroke in an Otto Cycle? Which properties remain constant during each process?
7) How does the first law of thermodynamics simplify for each process in the Otto Cycle?
8) What is the sign of the work transfer and heat transfer during each of the processes that make up an Otto Cycle?
9) What is the sign of work transfer and heat transfer across the entire Otto Cycle? What is the relationship between these quantities?
10) What is the equation for thermodynamic efficiency of an Otto Cycle, assuming constant specific heats? What variables have the greatest impact on this efficiency?

**Diesel Cycle Modeling – Study Questions**

1) What is the difference between the diesel cycle and dual cycle?
2) What is the direction of change in temperature, entropy, pressure, and volume during each of the processes that make up a Diesel Cycle?
3) What does a Diesel Cycle look like on a PV diagram?
4) What does a Diesel Cycle look like on a TS diagram?
5) What is the name of the thermodynamic process for each stroke in a Diesel Cycle? Which properties remain constant during each process?
6) What is the sign of the work transfer and heat transfer during each of the processes that make up a Diesel Cycle?
7) How does the first law of thermodynamics simplify for each process in the Diesel Cycle?
8) What is the sign of work transfer and heat transfer during each of the processes that make up a Diesel Cycle?
9) What is the sign of the work transfer and heat transfer across the entire Diesel Cycle? What is the relationship between these quantities?
10) What is meant by the cutoff ratio?
11) What is the equation for thermodynamic efficiency of a Diesel Cycle, assuming constant specific heats? What variables have the greatest impact on this efficiency?

**Dual Cycle – Study Questions**

1) Answer the same questions posed for the Diesel Cycle?
2) How does the dual cycle efficiency compare to Otto cycle efficiency and Diesel cycle efficiency?

**MEP Modeling – Study Questions**

1) What is mean by mean effective pressure? Why is this a useful concept?
2) How do you visualize mean effective pressure on a PV diagram?
3) What engine parameter is represented by $V_2 - V_1$?
4) What is the equation for engine power output? What variables are involved?
5) How is engine power output related to engine torque?
6) How is engine torque output related to mean effective pressure?
7) What variables influence mean effective pressure?
8) How does increasing each of these variables impact the mean effective pressure?
9) What changes in engine design or operating conditions increase in each variable? Why?
10) Is mean effective pressure a function of engine speed? Why?

**Gas Exchange Processes – Study Questions**

1) What does a PV diagram look like for an unthrottled Otto Cycle?
2) What does a PV diagram look like for a throttled Otto Cycle? What is the impact of throttled operation on the specific work of the cycle? How can you tell from the PV diagram?
3) What does a PV diagram look like for a supercharged Otto Cycle? What is the impact of the throttle operation on the specific work of the cycle? How can you tell from the PV diagram?
4) What is meant by blowdown? How does this impact specific work of an engine cycle?
5) What is meant by displacement? How is this achieved?
6) What is residual gas? Does this apply to both SI and CI engines? Why?
7) What are typical values for the residual gas fraction? What engine conditions would cause the residual gas fraction to increase?
8) Why is the residual gas fraction lower for compression ignition engines?
9) How does the residual gas fraction impact intake temperature?
10) What is the impact of valve overlap under part throttle condition?
11) What is the impact of valve overlap at wide open throttle?
12) What is the impact of valve overlap during supercharging?
13) How is valve timing adjusted between conventional and high performance engines? Why?
14) What is meant by volumetric efficiency and how does this impact engine performance?
15) What is the relative contribution to volumetric efficiency at different engine speeds? Why?