EML 4930, 5930 Internal Combustion Engines Feb. 19, 1996

Test 1

1. What are the possible symptoms and coresponding remedies when an engine can not be started?

2. Consider an air-standard Otto cycle that has a heat addition of 2000kJ per kg of air, a compression ratio of 9, and a pressure and temperature at the beginning of the compression process of 100 kPa, 15 ^{o}C. Determine the following:

The maximum pressure and temperature for this cycle.

The mean effective pressure.

3. Butane (C_4H_{10}) is burned with air and a volumetric analysis of the combustion products on a dry basis yields the following composition:

CO_2	7.8%
CO	1.1
O_2	8.2
N^*_2	82.9

Determine the equivalence ratio used in this combustion process.

4. Consider that the fuel of a gasoline engine is to be replaced by butyl alcohol(C_4H_9OH). Estimate the power output in percentage of power produced by burning gasoline. The lower calorific value for burning gaseous octane is 44 788 kJ/kg. The molecular weight of butyl alcohol is 74. The lower calorific value for gaseous butyl alcohol is 33 222 kJ/kg.

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TEST II

1. Some combustion products at a pressure of 2 atm. are in thermal equilibrium at 1400 K, and a volumetric gas analysis yielded the following data:

CO_2	0.065
H_2O	0.092
CO	0.040

Find the molar fraction of H_2 from the equilibrium equation.

2. A mixture of one kmol CO_2, 0.5 kmol CO and 2 kmol O_2 at 25^0C and 150 kPa pressure is heated in a constant pressure steady-flow process to 3000 K. Determine the equilibrium composition at 3000 K, assuming the reaction equation to be

$$CO_2 \Leftrightarrow CO + 0.5\ O_2$$

3. In the study of detonation wave in internal combustion engines, what are the assumptions and given conditions? Describe the procedure for the calculation of the wave speed.

4. Consider a single cylinder four stroke piston engine. Suppose that properties and geometries of the parts are given. How will you determine the torques on the crank for different crank angles.

5. Draw the schematic circuit diagram for an electronic ignition system. Explain how it works. What is the most possible trouble and what is the remedy?

Note that you must choose one problem from 1 or 2, and two problems from 3, 4, and 5.

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Final Examination

1. After having studied this course, we know that to the maximum, the thermal efficiency of internal combustion engines is in the order of 30%. (A) What are the causes of energy wasted? (B) State possible ways to improve the efficiency of internal combustion engines. (C) What will be the ideal way to use the chemical energy of the fuel?

2. Draw a schematic diagram for a fuel system. Discuss the possible troubles, symptoms and corresponding remedies.

3. Methyl alcohol (CH_3OH) at 25 ^oC, 0.1 MPa is burned with 120% theoretical air, after which the products of combustion are passed through a heat exchanger and cooled to 50 ^oC. Considering the process to be steady-flow, calculate the heat transfer per kmol of fuel.

4. The two-cylinder opposed-piston engine shown below is running at 4,000 rpm. the total reciprocating mass at each piston is 3.5 lb, and the two connecting rods (each 6.5 in long) are joined to a common crank which is 2 in long. Assume that $M_c''+2M_c'$(the total equivalent mass at the crankpin) has been balanced by counterbalance mass opposite the crank. (A) Determine whether the primary or secondary force are balanced or unbalanced. (B) Compute the values the inertia forces and the magnitude and direction of their resultant at the instant.