國立臺灣大學 106 學年度碩士班招生考試試題

Air is treated as an ideal gas (density 1.12 kg/m^3, specific heats 1.005 kJ/kg, molecular weight 28.97 kg/kmol), 0°C =273.15 K, the university gas constant 8314 J/kmol·K.

1. Discuss the work and heat transfer in the *p-v* and *T-s* diagrams of (a) air-standard Otto cycle and (b) air-standard Diesel cycle. (20%)

2. A rigid and insulated container of 3 m^3 is divided into two spaces by a partition with negligible size. The left space is initially filled by air at 3 atm and 100°C, whereas the right one is evacuated. A final equilibrium of 2 atm is reached after the partition is removed. Determine (a) the final temperature after the equilibrium is achieved and (b) the volume ratio of the left space to the right one. (20%)

3. A fan installed at the back of a computer chassis is employed to remove the waste heat generated by the electronic elements inside a desktop computer, where the heat exchange between the computer chassis and the environment can be ignored. At steady state, the ambient air enters the computer enclosure at 23°C and 1.0 bar with negligible velocity. For geometric reasons, the fan diameter is limited to 23 cm. The temperature of the air exiting the computer enclosure cannot exceed 40°C for the purpose of a better temperature control. The fan receives an electric power of 23 W, which is one-fifth of the power consumed by the electronic elements. Determine the fan inlet velocity for which the limits on the fan diameter and the exit air temperature are met. (20%)

4. Air undergoes a compression process to a final state of 100°C. The air is initially at 1.3 bar, 25°C and with a volume of 3 m^3. If the process follows the relation $pV^{1.3}$ = constant, determine (a) the pressure at the final state, (b) the work done by air during the process, (c) the heat transfer to the environment during the process and (d) the entropy change of air during the process. (40%)

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