系所組別 航空太空工程學系甲、丁組

考試科目 熱力學

考試日期 0307，節次：1

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機 [共五題,每題各佔20%]

Prob.1 Please explain the definition of "energy" in classical thermodynamics.

Prob.2 Please illustrate the physical model of "ideal gas" as well as its applications on thermodynamic analysis.

Prob.3 The thermal efficiency of an Otto cycle is 60%. At the beginning of the compression stroke the pressure is 0.1 MPa and the temperature is 27 °C. The heat transfer to the air per cycle is 2000 kJ/kg air. Based on the cold air-standard analysis, determine:

(a) The compression ratio,

(b) The highest pressure of the cycle, and

(c) The highest temperature of the cycle.

[Let c_v= 0.7165 kJ/(kg-K), R= 0.287 kJ/(kg-K), and k=1.4 for air.]

Prob. 4 The Clausius statement of the second law of thermodynamics may be given as " It is impossible for any system to operate in such a way that the sole result would be an energy transfer by heat from a cooler to a hotter body" and the Kelvin-Planck statement of the second law gives " It is impossible for any system to operate in a thermodynamic cycle and deliver a net amount of work to its surroundings while receiving energy by heat transfer from a single thermal reservoir." (a) Please show the equivalence of the above two statements. The Carnot corollaries states: Corollary 1: The thermal efficiency of an irreversible power cycle is always less than the thermal efficiency of a reversible power cycle when each operates between the same two thermal reservoirs. Corollary 2: All reversible power cycles operating between the same two thermal reservoirs have the same thermal efficiency. (b) Please briefly describe the Carnot cycle and show that the Carnot cycle is a reversible power cycle in agreement with the above corollaries.

Prob. 5 Our government is promoting the "Energy Conservation Labeling programs" (節能標章). For air conditioning machines, it is found from the accreditation (認證) results for the recent few years that the average EER (Energy Efficiency Rating) value of the air conditioning product is 3.27 KW/KW. It is known from the textbook that EER(KW/KW)= COP_R，where COP is the Coefficient of Performance. Please (1)define COP_R , (2) Ii is found that this EER value is tested based upon the conditions of indoor: 27℃ DB/19.5℃ WB and outdoor: 35℃ DB/24℃ WB. Neglect the effect of humility for the moment, based upon the average EER value above, please estimate what percentage of air conditioning power is saved if we increase the air conditioning temperature by 1 ℃. (DB: dry-bulb, and WB: wet-bulb temperatures)