系所組別：航空太空工程學系甲、丁組

考試科目：熱力學

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Before introducing the temperature scale, Kelvin suggested a logarithmic scale in which the ratio of the heat transfers Q_C / Q_H can be expressed in terms of the function Ψ

   $$\Psi = \exp \theta_C / \exp \theta_H$$

   Where θ_H and θ_C denote, respectively, the temperatures of the hot and cold reservoirs on this scale.

   (a) Show that the relation between the Kelvin temperature T and the temperature θ is

   $$\theta = \ln T + C \quad , \quad \text{where C is a constant.}$$

   (b) On the Kelvin scale, temperatures vary from 0 to + ∞. Determine the range of temperature values on the logarithmic scale.

   (c) Obtain an expression for the thermal efficiency of any system undergoing a reversible power cycle while operating between reservoirs at temperatures θ_H and θ_C. (25 %)

2. Two reversible power cycles are arranged in series. The first cycle receives energy by heat transfer, Q_1, from a hot reservoir at temperature T_H and rejects energy by heat transfer, Q_2, to a reservoir at an intermediate temperature $T < T_H$. The second cycle receives energy by heat transfer, Q_3, from the reservoir at temperature T and rejects energy by heat transfer, Q_4,to a cold reservoir at temperature $T_C < T$.

   (a) Obtain an expression for the thermal efficiency of a single reversible power cycle operating between hot and cold reservoirs at T_H and T_C, respectively, in terms of the thermal efficiencies of the two cycles.

   (b)Obtain an expression for the intermediate temperature T in terms of T_H and T_C for the special case where the thermal efficiencies of the two cycles are equal.

   (c)Determine the entropy transfers of the first and the second power cycles. Determine the entropy change of the combined system composing the first and second cycles. (25 %)

3. Please give details why Carnot Cycle presents the highest thermal efficiency for power systems from the very basic. (25%)

4. Please compare and illustrate the advantages and disadvantages of the design and application of vapor power system and gas power system in general. (25%)