

國立臺北科技大學

九十三年學年度製造科技研究所入學考試

熱力學試題

填准考證號碼

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注意事項：

1. 本試題共 4 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

- (1) A Carnot engine operates between temperatures of 1000 K and 300 K. The engine operates at 2000 rev/min and develops 200 kW. The total engine displacement is such that the mean effective pressure is 300 kPa. Determine
- (a) the cycle efficiency ; (5%)
 - (b) the heat supplied (kW) ; (10%)
 - (c) the total engine displacement . (10%)
- (2) The following cycle involves 3 kg of air : polytropic compression from 1 to 2, where $p_1 = 150$ kPa, $T_1 = 360$ K, $p_2 = 750$ kPa, and $n = 1.2$; constant-pressure cooling from 2 to 3 ; and constant-temperature heating from 3 to 1.
- (a) sketch the P-V and T-S diagrams ; (10%)
 - (b) the net work ; (10%)
 - (c) the heat added. (5%)
- (3) Derive an expression for the change of internal energy of a gas using the Van der Waals equation of state. (25%)

- (4) A steam power plant operates on the Rankine cycle. The steam enters the turbine at 7.0 MPa and 550⁰ C with a velocity of 30 m /s. It discharges to the condenser at 20 kPa with a velocity of 90 m/s. Calculate the thermal efficiency and the net power produced, for a flow rate of 37.8 kg /s. (25%)

superheated steam: $p = 7.0 \text{ MPa}$; $T = 550^{\circ} \text{ C}$

$$v = 0.05195 \text{ m}^3/\text{kg} \quad , \quad u = 3167.2 \text{ kJ/kg} \quad , \quad s = 6.9486 \text{ kJ/kg} - \text{K}$$

saturated steam: $p = 20 \text{ kPa}$; $T = 60.06^{\circ} \text{ C}$

$$v_f = 0.001017 \text{ m}^3/\text{kg} \quad , \quad u_f = 251.38 \text{ kJ/kg} \quad , \quad s_f = 0.8320 \text{ kJ/kg} - \text{K}$$

$$v_g = 7.649 \text{ m}^3/\text{kg} \quad , \quad u_g = 2456.7 \text{ kJ/kg} \quad , \quad s_g = 7.9085 \text{ kJ/kg} - \text{K}$$