Thermodynamics (ESC-S202)

Lecture- 16
First Law of Thermodynamics

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Some Numerical Problem

P.K. NAG Engineering Thermodynamics

Example 4.4 *The internal energy of a certain substance is given by the following equation:*

$$u = 3.56\,pv + 84$$

where u is given in kJ/kg, p is in kPa, and v is in m^3/kg.

A system composed of 3 kg of this substance expands from an initial pressure of 500 kPa and a volume of 0.22 m^3 to a final pressure 100 kPa in a process in which pressure and volume are related by $pv^{1.2}$ = constant.

(a) If the expansion is quasi-static, find Q, ΔU, and W for the process.

(b) In another process the same system expands according to the same pressure-volume relationship as in part (a), and from the same initial state to the same final state as in part (a), but the heat transfer in this case is 30 kJ. Find the work transfer for this process.

(c) Explain the difference in work transfer in parts (a) and (b).

Q.4.1 of P.K. Nag Engineering Thermodynamics

An engine is tested by means of a water brake at 1000 rpm. The measured torque of the engine is 10000 mN and the water consumption of the brake is 0.5 m3/s, its inlet temperature being 20°C. Calculate the water temperature at exit, assuming that the whole of the engine power is ultimately transformed into heat which is absorbed by the cooling water.

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Example 4.3 *A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfers is – 170 kJ. The system completes 100 cycles per min. Complete the following table showing the method for each item, and compute the net rate of work output in kW.*

Process	Q (kJ/min)	W (kJ/min)	ΔE (kJ/min)
a–b	0	2,170	—
b–c	21,000	0	—
c–d	–2,100	—	–36,600
d–a	—	—	—