University of Warith Al-Anbiya'a
College of Engineering
Department:- A/C Techniques .
1st Year Clas

Subject: Thermodynamics -1-
Tutorial Sheet No. 4 by:
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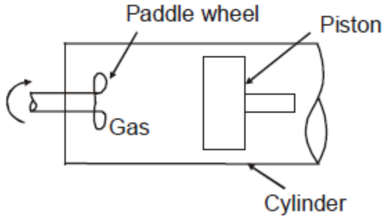
Lecture 7, 8 and 9 : Thermodynamic process

Prob. 4-1 / *Figure shows a system comprising of gas in cylinder at pressure of 689 kPa. Fluid expands from a volume of 0.04 m^3 to 0.045 m^3 while pressure remains constant. Paddle wheel in the system does a work of 4.88 kJ on the system. Determine (a) work done by system on the piston (b) the net amount of work done on or by the system.*



Prob. 4-2 / *A system comprising of a gas of 5 kg mass undergoes expansion process from 1MPa and 0.5 m^3 to 0.5 MPa. Expansion process is governed by, $p.v^{1.3}$ = constant. The internal energy of gas is given by, u = 1.8 pv + 85, kJ/kg. Here 'u' is specific internal energy, 'p' is pressure in kPa, 'v' is specific volume in m^3/kg. Determine heat and work interaction and change in internal energy.*

Prob. 4-3 / *Determine the heat transfer and its direction for a system in which a perfect gas having molecular weight of 16 is compressed from 101.3 kPa, 20°C to a pressure of 600 kPa following the law $pV^{1.3}$ = constant. Take specific heat at constant pressure of gas as 1.7 kJ/kg.K.*

Prob. 4-4 / *A cylinder contains 0.45 m3 of a gas at 1 × 105 N/m^2 and 80°C. The gas is compressed to a volume of 0.13 m^3, the final pressure being 5 × 105 N/m^2. Determine:*

(i) The mass of gas

(ii) The value of index 'n' for compression

(iii) The increase in internal energy of the gas

(iv) The heat received or rejected by the gas during compression. Take γ = 1.4, R = 294.2 J/kg°C.

Prob. 4-5 / *Air at 1.02 bar, 22°C, initially occupying a cylinder volume of 0.015 m^3, is compressed reversibly and adiabatically by a piston to a pressure of 6.8 bar. Calculate:*

(i) The final temperature

(ii) The final volume

(iii) The work done.

Prob. 4-6 / *0.44 kg of air at 180°C expands adiabatically to three times its original volume and during the process, there is a fall in temperature to 15°C. The work done during the process is 52.5 kJ. Calculate C_p and C_v .*

Prob. 4-7 / *1 kg of ethane (perfect) gas is compressed from 1.1 bar, 27°C according to a law $PV^{1.3}$ = constant, until the pressure is 6.6 bar. Calculate the heat flow to or from the cylinder walls.*

Prob. 4-8 / *0.1 m^3 of an ideal gas at 300 K and 1 bar is compressed adiabatically to 8 bar. It is then cooled at constant volume and further expanded isothermally so as to reach the condition from where it started. Calculate:*

(i) Pressure at the end of constant volume cooling.

(ii) Change in internal energy during constant volume process.

(iii) Net work done and heat transferred during the cycle.

Assume C_p = 14.3 kJ/kg K and C_v = 10.2 kJ/kg K.

Prob. 4-9 / *0.15 m^3 of an ideal gas at a pressure of 15 bar and 550 K is expanded isothermally to 4 times the initial volume. It is then cooled to 290 K at constant volume and then compressed back polytropically to its initial state. Calculate the net work done and heat transferred during the cycle.*