Faculty of sciences and technology
Department of engeneering process 2 nd worksheet
3 rd year students

Exercise 01 :

Show by considering $\phi = \phi\ (t, x, y, z)$ that the material derivative

$d \phi /dt = \partial \phi /\partial t + v \cdot \nabla \phi$

Exercise 02

A calorically imperfect ideal gas is known to have

$C_P (T) = C_{P0} + aT.$

sample of this gas begins at P_1, T_1. It is heated isobarically to T_2, and expanded isochorically to T_3.

Find the change in internal energy of the gas, $u_3 - u_1$

Exercise 03

Consider a pure fluid of one component. Show that

$$\left(\frac{\partial c_V}{\partial v}\right)_T = T\left(\frac{\partial^2 p}{\partial T^2}\right)_v .$$

Exercise 04

From stability arguments, show that the enthalpy of a pure fluid is a convex function of entropy and a concave function of pressure.

$$\left(\frac{\partial^2 h}{\partial s^2}\right)_p = \left(\frac{\partial T}{\partial s}\right)_p = \frac{T}{c_p} > 0.$$

Exercise 05

Determine the total differential of volume for an ideal gas dV