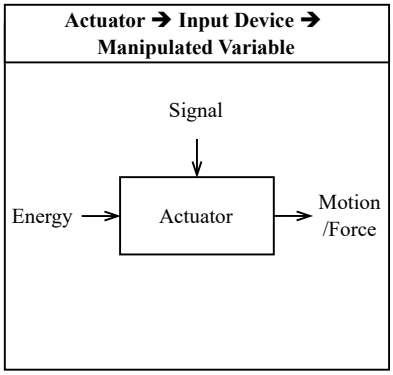
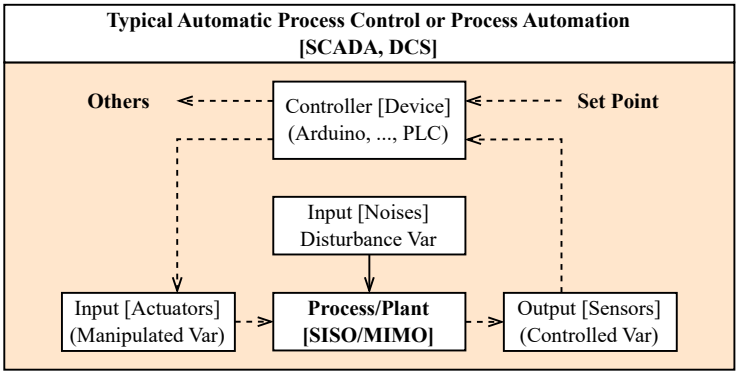
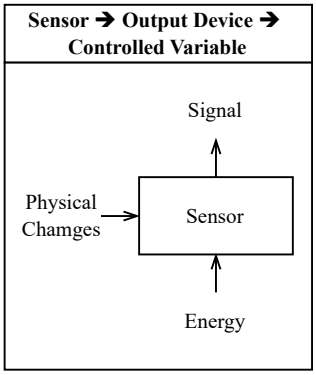
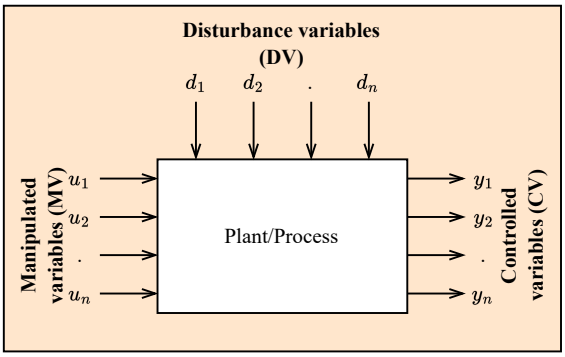






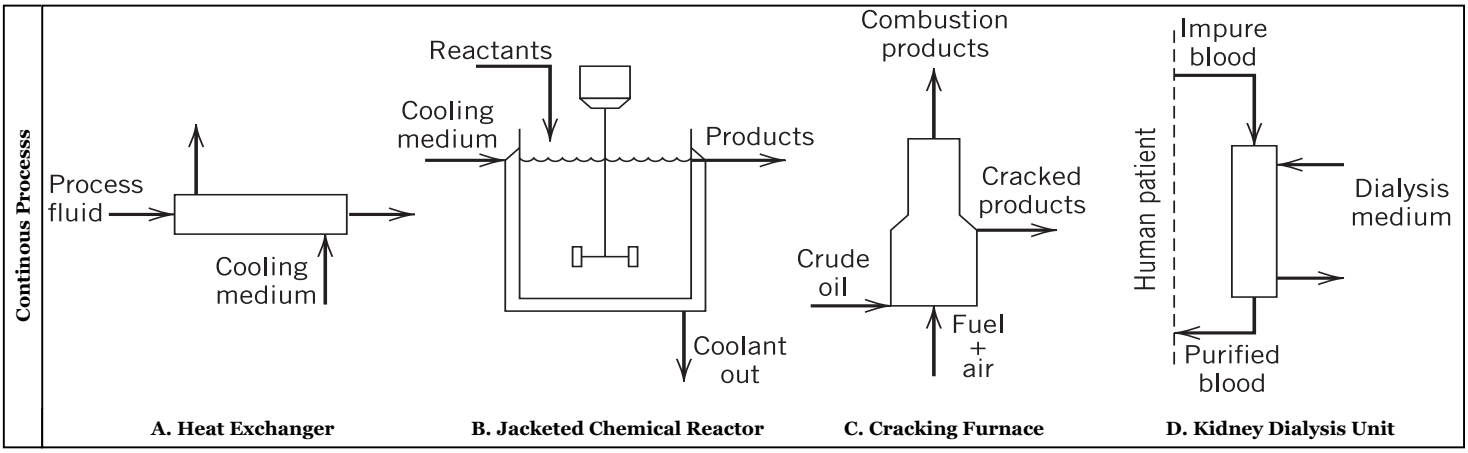
1.1 Process/Plant [SISO/MIMO]

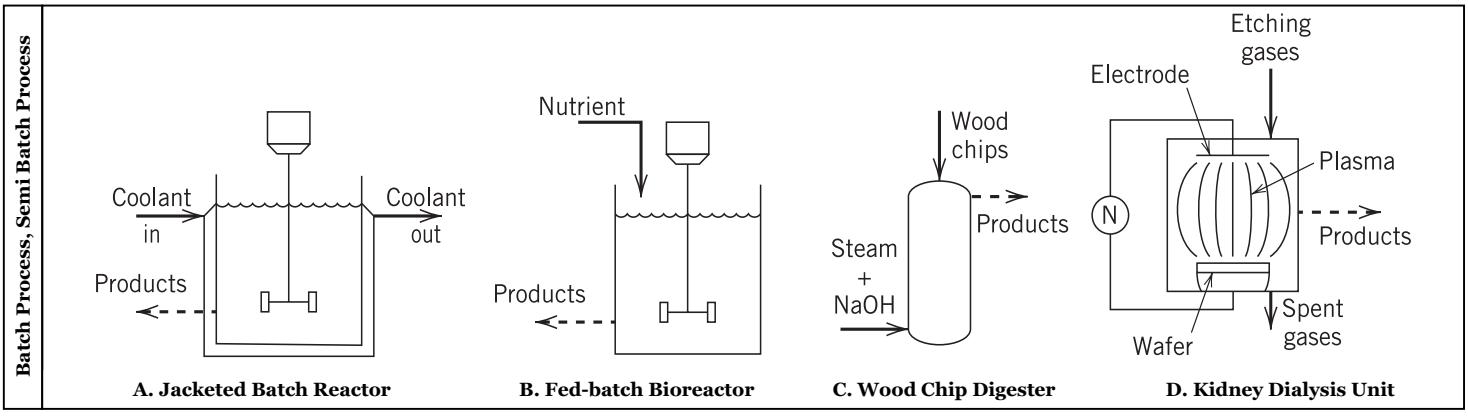


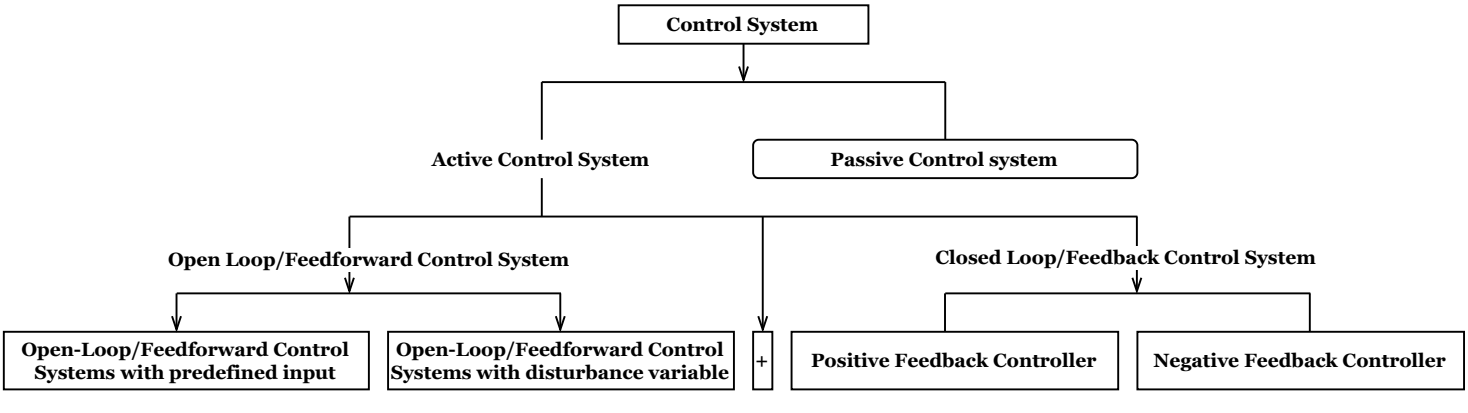
Process: The conversion of feed materials to products using chemical and physical operations. In practice, the term process tends to be used for both the processing operation and the processing equipment.

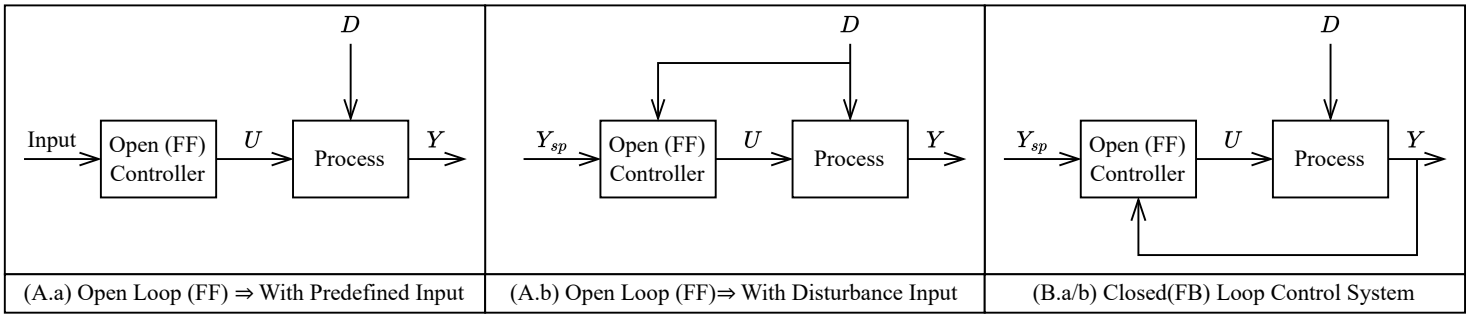
Process Variables Types: For each of these four examples, the process control problem has been characterized by identifying three important types of process variables.

▣ ***Controlled variables (CVs)***: The process variables that are controlled. The desired value of a controlled variable is referred to as its set point.
▣ ***Manipulated variables (MVs)***: The process variables that can be adjusted in order to keep the controlled variables at or near their set points. Typically, the manipulated variables are flow rates.
▣ ***Disturbance variables (DVs)***: Process variables that affect the controlled variables but cannot be manipulated.









(A.a) Open Loop (FF) ⇒ With Predefined Input | (A.b) Open Loop (FF)⇒ With Disturbance Input | (B.a/b) Closed(FB) Loop Control System

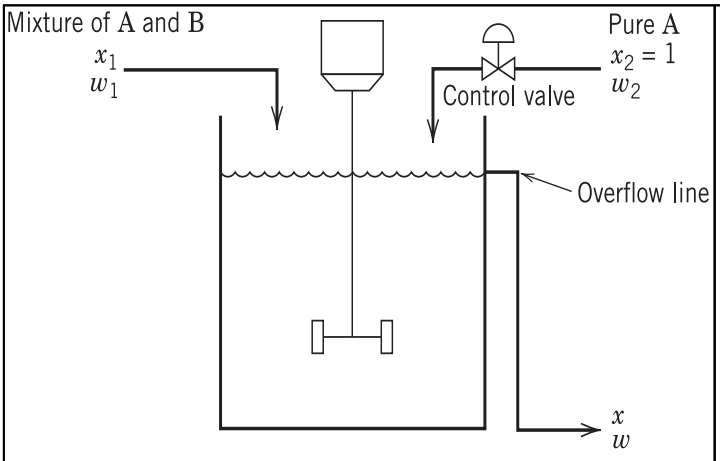


Figure 1.3 Stirred-tank blending system.

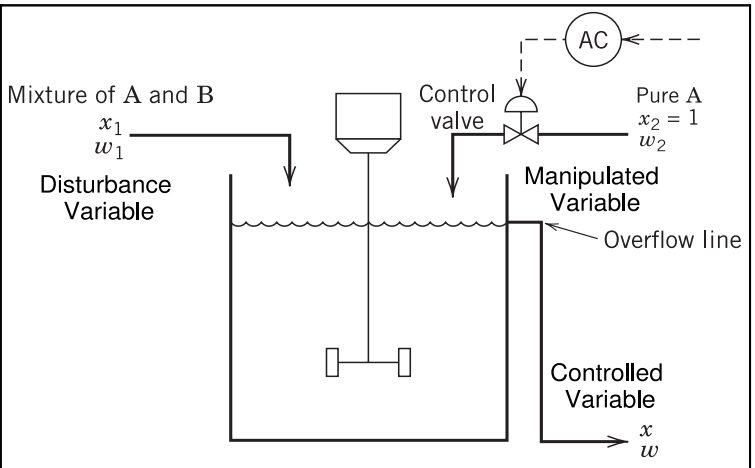


Figure 1.x Stirred-tank blending system. Control Method 0

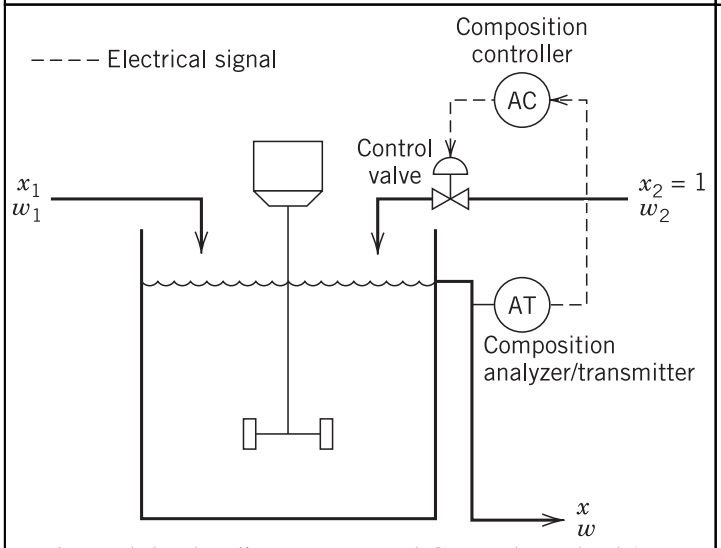


Figure 1.4 Blending system and Control Method 1.

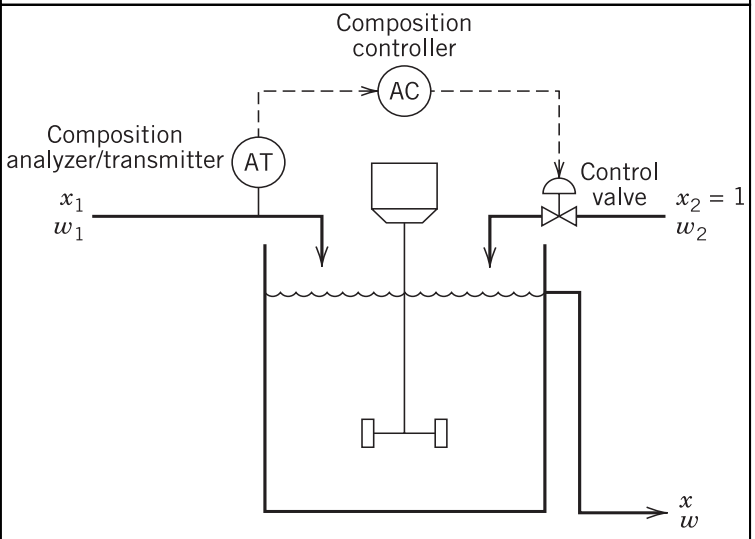
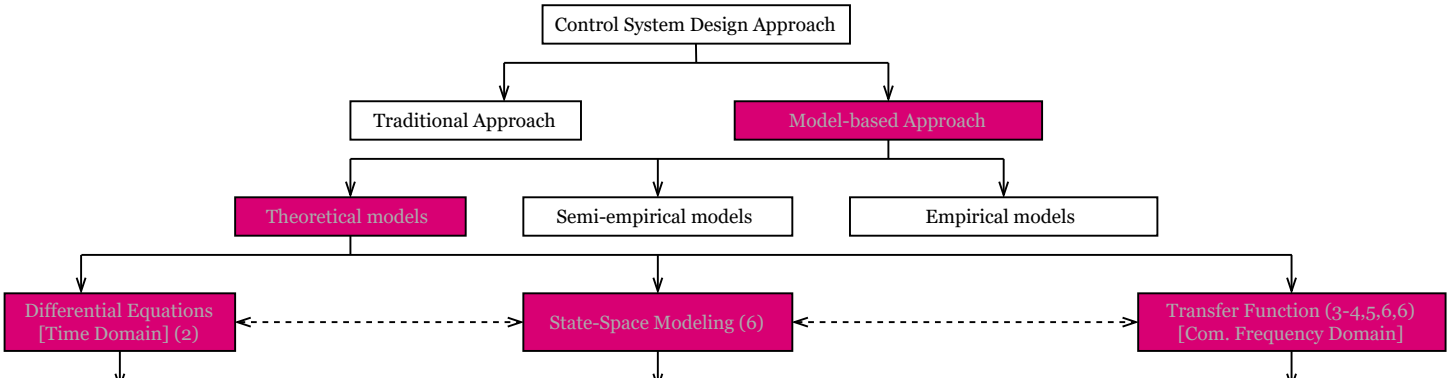


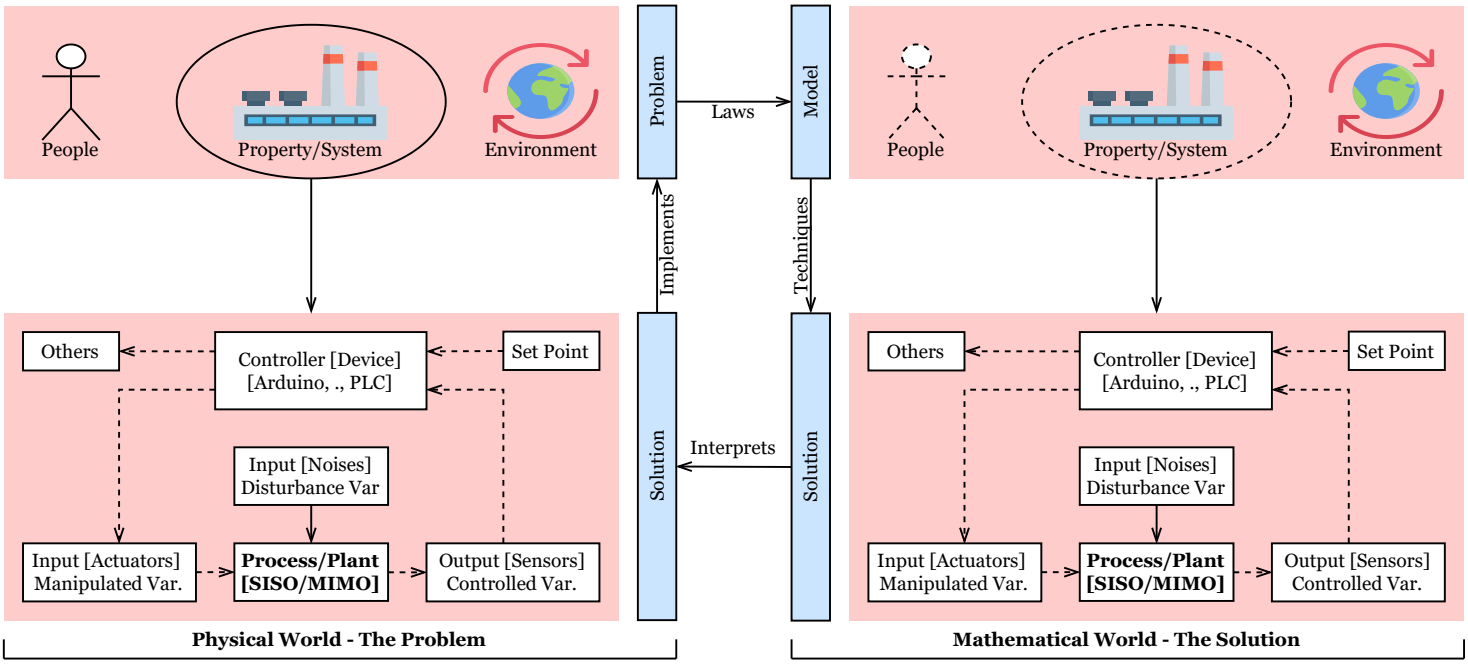
Figure 1.5 Blending system and Control Method 2.



Types of DE	Types
A. Acc. To Type	[ODE, PDE]
B. Acc. To Order	[1st, ..., nth order]
C. Acc. To Linearity	[Linear, Non-linear]
D. Acc. To Homogeneity	[Homo, Nonhomogeneous]

Analysis	Where?
A. Stability	System
B. Observability	Sensor
C. Controllability	Actuator
D. Sensitivity	System

Forms of TF - Linearized	Why?
A. Standard Form	Generalization of the System
B. Gain-Time Constant Form	Response of the System
C. Zero-Pole Form	Stability of the System
D. Matrix Form	MIMO Analysis of System



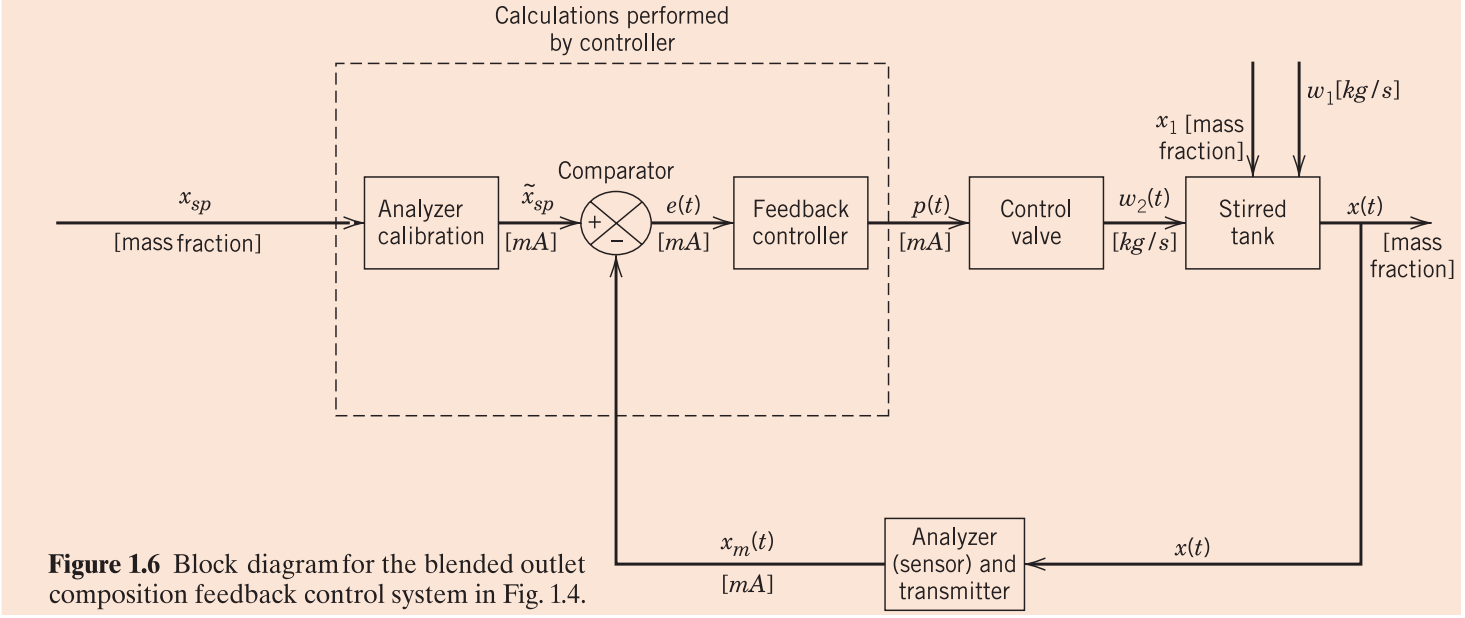


Figure 1.6 Block diagram for the blended outlet composition feedback control system in Fig. 1.4.

Extensive property	Symbol	SI units	Intensive (specific) property	Symbol	SI units	Intensive (molar) property	Symbol	SI units
2.8.1			Pressure	P	Pa or N/m^2			
2.8.2 Volume	V	m^3 or L	Specific volume*	v	m^3/kg or L/kg	Molar volume	V_m	m^3/mol
2.8.3			MassDensity(SG,SW)	ρ	kg/m^3			
2.8.4			Temperature	T	K			
2.8.7 Heat capacity at const. volume	C_V	J/K	Specific heat capacity at constant volume	c_V	J/(kg·K)	Molar heat capacity at constant volume	$C_{V,m}$	J/(mol·K)
2.8.7 Heat capacity at const. pressure	C_P	J/K	Specific heat capacity at constant pressure	c_P	J/(kg·K)	Molar heat capacity at constant pressure	$C_{P,m}$	J/(mol·K)
2.8.5 Internal energy	U	J	Specific internal en.	u	J/kg	Molar internal en.	U_m	J/mol
2.8.6 Enthalpy	H	J	Specific enthalpy	h	J/kg	Molar enthalpy	H_m	J/mol
2.8.8 Entropy	S	J/K	Specific entropy	s	J/(kg·K)	Molar entropy	S_m	J/(mol·K)
2.8.9 Helmholtz free en.	F	J	Spec. Helmholtz f . e.	f	J/kg	Molar Helmholtz fe	F_m	J/mol
2.8.10 Gibbs free energy	G	J	Specific Gibbs free e.	g	J/kg	Chemical potential	G_m or μ	J/mol