**ABE 202: Final Exam Review**

**Week 1: Basic definitions and concepts of thermodynamics; Refresher on Core Mathematics and Differential Equations for Thermodynamics**

**\*\***

dot= amount at certain time( difference form)(different from dM/dt)

hat=per unit mass

Underbar (ub)= per moleẆ

IG=ideal gas

EOS=equation of state

Derivative calc, solving problems

**Week 2: Building Blocks for Problem Solving; Differential Mass and Energy Balance Equations**

Derivation and discussion of extensive/intensive variables

First and second laws of thermodynamics

Applications of differential mass and energy to solve basic problems of engineering

Homework 1

Closed Systems

Half life

Mass balance with Chemical reactions

Differential form:

Difference form:

Molar Extent of Reaction(X)

**\*\*look for Chemical equilibrium problem w/ CH3COOH + C2H5OH <-> CH3COOC2H5 + H2O \*\***

**Week 3: Differential Mass and Energy Balance Equations; Differential Mass, Energy, and Entropy Balance Equations**

First Law of Thermodynamics: Conservation of Energy

E: internal energy

E: E1 + E2: extensive

Extensive

Linearly Additive: f(λx) = λf(x)

Energy flow(transfer)

Q= heat flow across boundaries

W=work energy flow

= Pressure Volume Work

Second Law of Thermodynamics: Tendency to Increase Disorder

If State B is Adiabatically accessible from State A, the SB ≥ SA.

Adiabatically= no heat flow across system boundaries.

\*can use temperature tor represent dE/dS.

Differential Energy Balance Equation

M = mass

Energy flow coming in with mass flow:

Heat:

Work:

=power volume work

\*\* important long equation in notes

Enthalpy

Special Cases:

1. Closed system:
2. Adiabatic system:

-Whenever you see Qdot, eliminate it

1. Open, steady-state system
2. Uniform system:

Energy Balance for Molar and Mass Basis

|  |  |
| --- | --- |
| Mass | Molar |
|  |  |
|  |  |
|  |  |

-Compressor example

General Equation(

Special Cases

1. Closed System: set Mdot,u = 0; dS/dt = Qdot/T + Sdot,gen
2. Adiabatic Processes: Qdot = 0
3. Reversible Process: Sdot,gen = 0
4. Open, steady-state: dS/dt = 0; 0 =
5. Uniform: S = MShat

Difference form

Special Cases:

1. Closed System: set Mdot,u = 0;
2. Adiabatic Processes: =0
3. Reversible Process:
4. Open, steady-state: flows of fluids that have constant properties. Set
5. Uniform: S = MShat

Magic refrigerator thought experiment/Magic engine thought experiment

Both are impossible, but as engineers, we design to get Sgen as close to 0 as possible

Differential Form of Mass, Energy, Entropy Balance Equations

(M:

E:

S:

\*\* Special cases for stuff

**Week 4: Gibb’s Free Energy; Introduction to Cells -- Cells by the Numbers**

Gibbs Free Energy

-Constant T, P

Ideal gas

dS,dE,dH,dG(all ub)----> T,V,P

**\***evolution of Phases/EOS equations

Cubic EOS

Compressibility factor

-Phase diagram in packet.

-Vander Waal’s EOS

-discusses basic principles

-runs through variables of gibbs

-Example problem with….

-goal is to minimize gibbs free energy

-Finding delta\_G of reversible or limiting reagent problems

**Week 5: Differential Thermodynamic Equations at Cellular Scale**

Applications of mass, energy, and entropy to cell systems

Ideal gas- a gas where there are no intermolecular forms that cause nonlinearities- strong forces between molecules do not play a large role in screwing things up.

PVub = RT

Heat Capacity

C= parameter

N= number of moles or amount

For ideal gas: Cp\*(T) = dHub/dT, Cv\*(T) = dUub/dT

Cp\* = Cv\* + R for gases

Cp\* = Cv\* for solids, liquids

-tank steady-state temp problem

**Week 6: Exam 1**

**Week 7: Introduction to Physical Limits in Cells; Physical Limits in Cells**

Ensembles of binding

Transcription control

**Week 8: Intro to gene control in cells; Models of Gene Control**

Thermodynamic limitations of gene control

**Week 9: Introduction to thermodynamics of vapors and liquids**

* Phase equilibrium
  + When both areas are equal to one another
* P-V diagram rules during construction

**Week 11: Thermodynamics of Metabolism; Vapor/Liquid Equilibrium**

* Problems relating to and its varying conditions

Gibbs

* Applications
  + Energy ---> Phase equilibrium
  + Chemical reactions equilibrium + calculations
* Gene activation and repression

**Week 12: Exam 2; Fugacity**

* Phase equilibrium
  + When both areas are equal to one another
* P-V diagram rules during construction

Fugacity-the fleeing tendency of a particle

Heat - the fleeing tendency for both particle +fugacity phases, the Gibb’s Free Energy of

the liquid and vapor phases must be equal

**Week 13: VLE and Integration; VLE**

**Week 14-16: Computational Methods for Thermodynamics in Cells and Tissues**