JOHN CABOT UNIVERSITY

COURSE CODE: ENGR 200
COURSE NAME: "Material and Energy Balances"
Summer Session Sample Syllabus

TOTAL NO. OF CONTACT HOURS: 45 lecture + 15 hours problem-solving sessions.

CREDITS: 3
PREREQUISITES: None

COURSE DESCRIPTION:

This course will introduce the student to chemical engineering and the fundamental principles of chemical process analysis. The student will gain experience in the application of problem-solving techniques in a variety of process-related problems. Aspects of professional development as a chemical engineer will be presented and integrated into course material.

SUMMARY OF COURSE CONTENT:

Chemical engineering calculations. Synthesis of chemical process systems. Analysis of chemical processes using material and energy balances. Enthalpy calculations for changes in temperature, phase transitions, and chemical reactions.

LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

1. Convert quantities among the SI, American English, and CGS unit systems with appropriate significant figures.
2. Create representative process flow diagrams and use them to organize systems of equations.
3. Derive energy balances for chemical processes and integrate with material balance calculations to solve for energy inputs and/or outputs.
4. Analyze and solve material and energy balances for steady state, single and multi-unit processes without reactions.
5. Analyze and solve material and energy balances for steady state, single and multi-unit processes with reactions.
6. Identify and calculate physical and chemical properties for compounds using data and physical properties from tabulated sources (e.g., steam tables, Txy and Pxy diagrams, psychrometric charts) and equations of state.
7. Apply basic mathematical and computational tools that support problem solving in this course (Excel, Matlab, or basic Aspen).
8. Gain an understanding of professional and ethical responsibilities through discussions and presentation of codes of professional ethics.

TEXTBOOK:

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Elementary Principles of Chemical Processes, 4th edition, R.M. Felder, R.W. Rousseau, and L.G. Bullard, John Wiley and Sons, 2016.

Students are required to purchase the eBook and WileyPLUS bundle directly from the publisher.

SCHEDULE

Week 1 Ch. 1 – What some chemical engineers do for a living
Ch. 2 – Introduction to engineering calculations (units and dimensions, weight, dimensional homogeneity)
Ch. 3 – Processes and process variables (mass and volume, flow rate, chemical composition, pressure, temperature)
Ch. 4 – Fundamentals of material balances (process classification, material balance calculations, multiple-unit processes)

Week 2 Ch. 4 – Fundamentals of material balances (recycle and bypass, stoichiometry, reactive processes, combustion)
Ch. 5 – Single-phase systems (densities, ideal gases, equations of gas for non-ideal gases, compressibility factor equation of state)
Ch. 6 – Multiphase systems (single component phase equilibrium, Gibbs phase rule)

Week 3 Ch. 6 – Multiphase systems (gas-liquid systems, multicomponent systems, solutions of solids in liquids)
Ch. 7 – Energy and energy balances (first law of thermodynamics, kinetic and potential energy, energy balances on closed systems)

Week 4 Ch. 7 – Energy and energy balances (energy balances on open systems at steady state, thermodynamic data)
Ch. 8 – Balances on nonreactive processes (energy balance calculations, changes in pressure at constant temperature, changes in temperature, phase-change operations)

Week 5 Ch. 9 – Balances on reactive processes (heats of reaction, Hess's law, formation reactions and heats of formation, heats of combustion, energy balances on reactive processes, fuels and combustion)

Final Exam on Friday