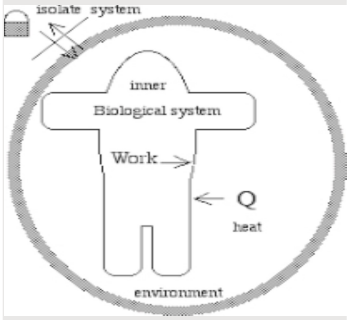
19BT212 BIOTHERMODYNAMICS



Source:
http://aris.gusc.lv/BioThermodynamics/BioThermodynamics.pdf

Hours Per Week :

L	T	P	C
3	0	-	3

Total Hours :

L	T	P
45	0	-

WA/RA	SSH/HSH	CS	SA	S	BS
5	45	-	8	2	2

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the laws of thermodynamics and their applications to estimate thermodynamic properties of substances. It imprts knowledge of estimation of property changes of the process and determining equilibrium states of the system. The objectives of the course are to familiarize the students about the three laws of thermodynamics, phase equilibrium and chemical reaction equilibrium.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand the laws of thermodynamics, phase equilibrium and chemical reaction equilibrium.	1,2
2	Apply the first law of thermodynamics for calculation of heat and work requirement for the process.	1
3	Analyze the entropy changes of processes by applying second law of thermodynamics.	2
4	Calculate thermodynamic properties of system for a given process by applying various thermodynamic property relations.	3
5	Evaluate the phase equilibrium for multi component solutions.	3

SKILLS:

- ✓ *Calculate heat and work requirements for industrial processes.*
- ✓ *Estimation of properties of systems.*
- ✓ *Expertise on phase equilibrium calculations.*
- ✓ *Capability of estimation of chemical reaction equilibrium.*

UNIT - I **L-9**

LAWS OF THERMODYNAMICS: First law of thermodynamics and other basic concepts, Calculation of work, Energy and property changes in reversible processes; Statements of the second law, Heat engines, Thermodynamic temperature scales; Entropy, Entropy changes of an ideal gas; Third law of thermodynamics and entropy from the microscopic viewpoint; Zeroth law of thermodynamics.

UNIT - II **L-9**

THERMODYNAMIC PROPERTIES: Fundamental property relations, Maxwell relationships and their applications; Partial molar properties, Concepts of chemical potential and fugacity, Activity coefficient; Ideal and non-ideal solutions; Gibbs Duhem equation.

UNIT - III **L-9**

PHASE EQUILIBRIUM: Criteria for phase equilibrium; Duhems theorem; Vapor-liquid equilibrium calculations; Phase diagrams for binary solutions; Liquid-liquid equilibrium, Solid-liquid equilibria.

UNIT - IV **L-9**

CHEMICAL REACTION EQUILIBRIUM: Equilibrium criteria for homogeneous chemical reactions; Evaluation of equilibrium constant and effect of pressure and temperature on equilibrium constant; Calculation of equilibrium conversions and yields for single and multiple chemical reactions.

UNIT - V **L-9**

BIOTHERMODYNAMICS: Bioenergetics, Thermodynamics of microbial growth, Stoichiometry of cell growth and product formation, Elemental balances, Degrees of reduction of substrate and biomass, Available electron balances, Yield coefficients of biomass and product formation, Maintenance coefficients; Oxygen consumption and heat evolution in aerobic cultures.

TEXT BOOK:

1. W. J. M. Smith, H. C. Van Ness and M. M. Abbott, “Introduction to Chemical Engineering Thermodynamics”, 5th edition, McGraw Hill, 2005.

REFERENCE BOOK:

1. K. V. Narayanan, “A Text Book of Chemical Engineering Thermodynamics”, 1st edition, Prentice Hall of India Publications, 2001.