BT 202

Biothermodynamics

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Semester 3, JUL-NOV

Lectures: 28, Tutorials: 14

Pre-requisites

NIL

This course is designed for second year undergraduates (B.Tech).

Objective

The aim of this core course is how thermodynamics can best be applied to applications and processes in biochemical engineering. It describes the rigorous application of thermodynamics in biochemical engineering to rationalize bioprocess development and obviate a substantial fraction of this need for tedious experimental work.

Course Content

Introduction to Thermodynamics: Energy, Energy Transfer, First Law of Thermodynamics, Entropy, Second & Thrid Law of Thermodynamics, Gibbs energy, governing equations for Mass, Energy and Entropy in closed and open systems, Refrigeration

Estimation of Thermodynamic Properties: Interrelation between thermodynamic properties of ideal and real gases; Equation of state, intensive and extensive properties, Interrelation between thermodynamic properties of water, Multi-phase systems, Steam table, Thermodynamic properties of mixture, phase equilibrium, Gibb's phase rule.

Thermodynamic aspects of Biological processes: Heat generation and energy dissipation of live cell growth process, thermodynamic prediction of kinetic parameters (e.g. yield coefficients, growth rate, specific rates, affinity constants), metabolic heat production, Gibbs energy dissipation for aerobic, fermentative and autotrophic cell growth, Biocalorimetry and its applications.

Thermodynamics of Metabolism: Black box thermodynamic analysis of Dicarboxylic acid production (e.g. Fumaric acid, succinic acid), maximum theoretic product yield, alkali consumption, osmotic stress and ionic strength, ATP synthesis for growth, thermodynamic feasibility analysis of metabolic pathways.

Text Books

1. Urs von Stockar, Biothermodynamics: The role of thermodynamics Biochemical Engineering, CRC Press, 2013.

2. Stanley I Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th Ed., Wiley Publishers, 2006.

References

1.Mustafa Ozilgen, Esra Sorguven, Bio-thermodynamics principles and applications, CRC Press, 2017

2. J.M Smith, H.C Van Ness and M.M Abott, Introduction to Chemical Engineering Thermodynamics, McGraw Hill (4th Ed), 1987.

Evaluation & Grading

Evaluation and Grading will be done as per the standard grading policy of the Institute.