


THERMODYNAMICS FOR BIOLOGICAL SYSTEMS: CLASSICAL AND STATISTICAL ASPECT

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TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE : 24 Apr 2022

PRE-REQUISITES : Undergraduate Mathematics

INTENDED AUDIENCE : Any Biological Engineering/Biological Sciences student or practitioner.

INDUSTRIES APPLICABLE TO : Biotechnology and other industries

COURSE OUTLINE :
Thermodynamics is one of the essential tools to analyze biological systems. Thus, it is essential that an undergraduate in biological engineering knows the relevant thermodynamics principles. Classical thermodynamics is suitable for analysis in the continuum domain, whereas when the number of molecules per cell is less than say 100, the principles of classical thermodynamics are invalid for that species. However, the principles of statistical thermodynamics can be used to analyze such situations, and other situations too. Therefore, this course will cover both classical and statistical aspects to provide a complete set of tools to a biological engineer to thermodynamically analyze bio-systems. Such an analysis will help in manipulation and design of bio-systems.

ABOUT INSTRUCTOR :
Prof. Sanjib Senapati is a Professor in the Department of Biotechnology, Indian Institute of Technology Madras (IITM). His research group at I.I.T. Madras focuses on understanding the relationship between protein structure, function, and dynamics.

Prof. G. K. Suraishkumar is a Professor in the Department of Biotechnology, Indian Institute of Technology Madras (IITM). He has been at IITM as a Professor since May 2004, and was earlier a faculty member in the Department of Chemical Engineering at the Indian Institute of Technology Bombay (IITB) from April 1993 until mid-May 2004. He was also an Associate Faculty member in the erstwhile Centre for Biotechnology, which is now the Department of Biosciences and Bioengineering, at IITB, between 1995 and 2004. He earned his Ph.D. from Drexel University, Philadelphia, USA in 1993, and his B.Tech. in Chemical Engineering from IITM in 1986. He also did his Masters work at the University of Cincinnati, USA, between 1986 and 1988.

COURSE PLAN :

Week 1: Review of concepts; Additional useful thermodynamic functions

Week 2: Additional useful thermodynamic functions (contd)

Week 3: Thermodynamic properties of pure fluids

Week 4: Thermodynamic properties of pure fluids (contd)

Week 5: Thermodynamics of solutions

Week 6: Thermodynamics of solutions (contd); Phase equilibria

Week 7: Phase equilibria (contd); Reaction equilibria

Week 8: Reaction equilibria (contd); Review

Week 9: Statistical Thermodynamics: Definition and Application

Week 10: Macrostates, Microstates, Partition function, Boltzmann Distribution Law

Week 11: Partition function and thermodynamic properties

Week 12: Ensemble and time average; Review