TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEMS

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PRE-REQUISITES : Undergraduate engineering mathematics
INTENDED AUDIENCE : Any biological engineering/biological sciences student or practitioner.
INDUSTRIES SUPPORT : Biotechnology and other industries

COURSE OUTLINE :
This course aims to fill the need for a comprehensive introduction to the analysis of biological systems in the continuum regime, in the context of transport (forces and fluxes). It aims to provide the student with the required skills to think-out-of-the-box in novelty requiring situations at one end, to a full appreciation of the relevant principles and their interconnections, at the other end. All the needed mathematical steps will be completely worked out to minimize the enormous time the students normally spend to understand the mathematical steps.

ABOUT INSTRUCTOR :
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.

He is passionate about improving student learning and has published papers in reputed international journals on the methods that he had developed for the same. He is the author of a book, Continuum Analysis of Biological Systems: Conserved Quantities, Fluxes, and Forces, which was published world-wide by Springer Publishing in March 2014; the foreword has been written by the reputed author of the famous textbook, Transport Phenomena, Professor R. B. Bird. Recently, he created two 10-h MOOCs on Bioreactors, and Biology for Engineers and other Non-biologists as NPTEL online certification (NOC) courses. Earlier, he created a 40-lecture NPTEL video course on Classical Thermodynamics for Biological Systems. He has also created other short videos on biochemical engineering principles.

His major area of research is reactive species – currently, the relevance of them in cancer and nanoparticle toxicity. Earlier, his research group had made significant, original contributions in the area of reactive species applied to improve bioreactor productivities and bio-oil which were financially supported through many sponsored research grants. The research contributions have been better disseminated through publications in reputed international journals– the complete list of publications is available as a link from his Department webpage, https://biotech.iitm.ac.in/faculty/suraishkumar-g-k/). He is also the inventor on 3 (granted) + 3 (under process) patents. Further, the technology developed in his group was successfully applied at Biocon industries, and has been featured in prestigious technology alerts such as the one by Frost and Sullivan. He has guided many Ph.D., and Masters theses. Some recognitions of his work by others are listed in his web-page given above.

Administratively, he played pivotal roles in the set-up of the Departments of Biotechnology, as the first formal Department Head, first at IIT Madras and later, at IIT Hyderabad. He was one of the main architects of the first postgraduate program in Clinical Engineering in India, which is a multi-Institute program, and a first of its kind in India. In addition, he contributed as the Head of the Sophisticated Analytical Instrumentation Facility, Chennai. He continues to contribute on National level faculty selection/ advisory/institution level committees in relevant areas.

COURSE PLAN :
Week 1**:** Introduction; Mass conservation principle
Week 2**:** Mass flux
Week 3**:** Mass flux contd.; Review
Week 4**:** Momentum flux
Week 5**:** Momentum flux (cont'd)
Week 6**:** Momentum flux (cont'd)
Week 7**:** Momentum flux (cont'd)
Week 8**:** Energy (heat) flux (cont'd); Review
Week 9**:** Charge flux; Review
Week 10**:** Fluxes under simultaneous, multiple driving forces
Week 11**:** Fluxes under simultaneous, multiple driving forces (cont'd)
Week 12**:** Fluxes under simultaneous, multiple driving forces (cont'd);Review