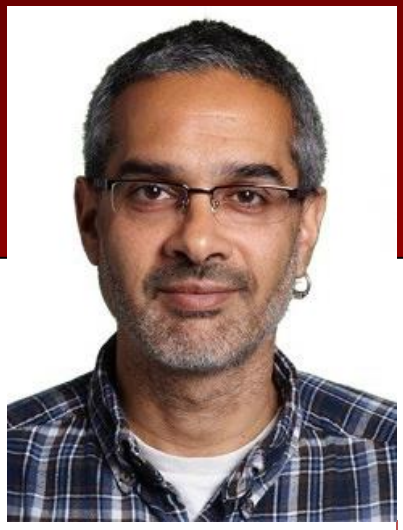

Department of Mathematical Sciences welcomes

Amitabha Bose
New Jersey Institute of Technology

Understanding entrainment properties of circadian oscillator models using a one-dimensional map

September 21, 2018

Hosted by:
Prof. Leonid Rubchinksky

Tea begins at 3:00
in LD 259

Research Topic
begins at 3:30
in LD 229

ABSTRACT:

A central feature of many oscillatory networks is their ability to display phase-locked solutions where the constituent elements fall into a well-defined pattern in which the phase difference between pairs of oscillators can be determined. Often the networks contain an identifiable pacemaker or external forcing. In these cases, the network is said to be entrained, because the pacemaker determines the overall network period and phasing. In this talk, we consider entrainment that arises in circadian systems. Such networks are subject to an external, pacemaking 24 hour light-dark drive in which the intensity and total hours of light within the 24 hour cycle are important parameters. We will introduce a new computational tool, a 1-dimensional entrainment map to assess whether and at what phase a circadian oscillator entrains to periodic light-dark (LD) forcing. We have applied the map to a variety of circadian oscillators ranging from the Novak-Tyson model for protein-mRNA interactions to the Kronauer model of the human circadian rhythm. Using the entrainment map, we systematically investigate how various intrinsic properties of the circadian oscillator interact with properties of the LD forcing to produce stable circadian rhythms. We will focus on how to use the map to study the reentrainment process due to jet lag after long-distance travel to address the so-called east-west asymmetry of jet lag. Further, we show that individuals can experience jet lag after purely north-south travel. The mathematical and computational methods used to study these problems should be of wide interest to members of the mathematics community.

ABOUT THE SPEAKER:

Amitabha Bose has been a member of the Department of Mathematical Sciences at NJIT for the past 22 years where he teaches a variety of undergraduate and graduate courses. His primary area of research is the application of mathematics to problems in neuroscience. He has developed mathematical models that describe neuronal and oscillatory activity including those related to learning and memory, REM and non-REM sleep, circadian rhythms and, most recently, rhythmic beat generation in the context of music. In 2009-2010, Dr. Bose was a recipient of a Senior Research Fellowship from the Fulbright Foundation.

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