



**Princeton University**

**Department of Electrical Engineering**

# Optical and Optoelectronic Engineering

**Speaker:** Dr. Sukhdev Roy, Deemed University

**Date:** Thursday, June 21, 2007

**Time:** 3:00pm

**Room:** B205 ~ Equad

**Title:** "Switching Light with Light in Natural Photoreceptors"

**Abstract:** Light sustains life on earth. It is one of the most important signals providing information to biological systems. Plants, seaweeds, and photo-synthesizing bacteria absorb sunlight and convert it into their life energy. In addition to human vision, light controls movement, growth, differentiation, development, circadian clock and a host of gene-expression responses in diverse organisms, from the simplest unicellular microorganisms through higher plants and animals.

During the past decade there has been extraordinary progress in identifying and characterizing photosensory receptors in a broad range of organisms to understand the signal transduction pathways and get an insight into their multifunctional response. An interesting proposition is whether these natural photoreceptors optimized over centuries of evolution can be used for photonic applications. The powerful capabilities of nano and biotechnologies can also tailor or optimize their photoresponse to meet desired specifications.

Since information forms the basis of modern technology, the possibility of using bio-molecules for information processing is extremely fascinating. The present challenge is to achieve all-optical information processing, to meet the anticipated demand for ultra-high bandwidth high-speed information processing. This requires an efficient nonlinear optical material response that is naturally exhibited by biomolecules.

A switch is the basic building block of information processing systems. The talk would focus on some of our recent results on all-optical switching in photosensitive biomolecules, namely archaeal rhodopsin proteins: bacteriorhodopsin, pharaonis phoborhodopsin (a sensory rhodopsin II) and proteorhodopsin, plant based LOV2 phototropin and chlorophyll-A, and photoactive yellow protein, based on excited-state absorption. We would also discuss its application to design low power all-optical biomolecular computing devices such as switches, spatial light modulators and logic gates and compare their performance with other organic molecules.