# Global Initiative on Academic Network (GIAN)

Course Title: **QUANTUM INSPIRED SOFT COMPUTING**
**27-31 October, 2017**

**Overview**

Quantum computing takes advantage of the rather odd and counterintuitive rules of quantum mechanics, like superposition (a quantum system can be in more than one state or even more than one place simultaneously), entanglement (instantaneous interaction at a distance), and quantum tunneling (a quantum system can switch states without surmounting an energy barrier between.) Using these, a quantum computer can solve classical computing "hard problems", and even quantum problems that are classically impossible to formulate and/or solve. The downsides are that quantum computers are very difficult to build and operate on a large scale, and that designing algorithms that take advantage of quantum mechanics is very difficult.

In this Course, we will give an introduction to quantum mechanics, to reach a workable understanding of its rules. We will then show how to exploit these rules to do quantum computing, to do classically difficult problems. We will then discuss quantum inspired soft computing, and show how imitating quantum dynamics and thermodynamics can be a powerful tool to deal with both downsides mentioned above, and can faster lead to better solutions. In the tutorials, we will explore specific examples of quantum machine learning.

**Objectives**

The major objectives of the course are as follows:

- Exposing participants to the fundamentals of quantum mechanics
- Building understanding of the tools of quantum computing and quantum inspired soft computing
- Introducing the applications of quantum inspired soft computing to engineering problem solving
- Enhancing capability of participants to use these tools to solve problems
- Teaching Faculty with allotment of Lectures and Tutorials

## Course details

The proposed course will cover several topics including fundamentals of quantum mechanics, quantum inspired soft computing encompassing quantum neural networks and quantum inspired metaheuristics to name a few. The course will include special tutorial sessions including lab demonstration covering several topics such as Schrondinger algorithm, quantum backprropagation, quantum Multilayer Self Organizing Neural Network Architecture (QMLSONN), quantum Hopfield network, quantum neural entanglement and designing of several quantum inspired metaheuristic algorithms.

## Teaching Faculty

**Prof. Elizabeth C. Behrman** earned her bachelor's in mathematics from Brown University in 1979, her master's in chemistry and her PhD in physics from University of Illinois at Urbana-Champaign in 1981 and 1985, respectively.

She is currently full professor of both physics and mathematics at Wichita State University in Wichita, Kansas. She served as Chair of the department from 2003 to 2006, as Associate Director of the university Honors program from 1999 to 2003, as Faculty Fellow from 2003 to 2009, and as Faculty Senate President from 2003 to 2004. Prior to this, she was Associate Professor of Physics at Wichita State from 1994 to 2002, and Assistant Professor of Physics at Wichita State from 1990 to 1994. Before coming to Wichita State she was Assistant Professor of Ceramic Engineering at the New York State College of Ceramics at Alfred University, in Alfred, NY, and before that a Postdoctoral Research Associate at the State University of New York at Stony Brook, NY.

She has won numerous honors, including, at Wichita State, the President's Distinguished Service Award (2015), and the Academy for Effective Teaching Award (2012.) She was appointed a Kavli Institute for Theoretical Physics Scholar (2006-2009) and a Lady Davis Fellow at Hebrew University in Jerusalem, Israel. She is a member both Sigma Xi and Phi Kappa Phi, and received both graduate and undergraduate research fellowships.

Her research interests and publications are broad, with over 80 papers in subjects ranging from chemical kinetics and reaction pathways to ceramic superconductors to nuclear waste vitrification. She was the first to predict the stability of inorganic buckyballs and buckytubes. Her major focus for several decades has been quantum information, particularly quantum machine learning, where her group has published seminal papers on temporal and spatial quantum backpropagation, quantum Hopfield networks, quantum genetic algorithm, and quantum ants.

[More about Prof. E. C. Behrman:
http://webs.wichita.edu/?u=mspphys&p=/faculty_and_staff/behrman/]

**Who can attend:**

- Students (Masters and Ph.D), postdocs and scientists/faculty members from academic and technical institutions.
- Researchers and engineers from R&D laboratories and industries

**To apply for the course, follow the instructions given here:**

**Registration Fees**

**Participants from abroad:** $250

**Industry/Research Organization:** INR 25,000

**Academic Institution:** Students: INR 3,000
Scientists/Faculty members: INR 6,000

**Course Co-ordinator**

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