ICT 4011: **NATURAL COMPUTING** **[3 0 0 3]**

Objectives:

- To understand various existing computing in nature.
- To give the student an introduction to various algorithms in the area of natural computing and show how they have proven to be very powerful in solving various kinds of problems.
- To have basic proficiency in using softwares such as Xgrow, Xtile, ISUTAS, CadNano, Sarse, Tiamat, Chemical Compiler etc

Abstract:
Basic Notations of Biochemistry and Molecular Biology, DNA Computing, Basic Computing Models: Finite Automata (FA), Push Down Automata (PDA), Linear Bounded Automata (LBA) and Turing Machine (TM), Quantum Turing Machine (QTM) and Quantum Languages, Computation by circuits, Thermodynamics of Computation, Algorithmic Botany, Cellular Automata, DNA Computation Models:Lipton Model, Sticker model, DNA Splicing model, DNA Self Assembly, Hairpin Model, Algorithms for Natural Security and Cryptography, Experiments in Self-Assembly, DNA Origami (2D and 3D), Error-Correction in Self- Assembly, Bacterial Computers and Data Storage, Peptide Computing, Membrane Computing, Chemical Computing

Syllabus:

Basic Notations of Biochemistry and Molecular Biology **[2 Hours]**

DNA Computing:
Introduction, Encoding scheme, Comparison with conventional computing, Application of DNA computing **[4 Hours]**

Basic Computing Models:
Finite Automata (FA), Push Down Automata (PDA), Linear Bounded Automata (LBA) and Turing Machine (TM), Quantum Turing Machine (QTM) and Quantum Languages, Computation by circuits, Thermodynamics of Computation, Algorithmic Botany, Cellular Automata **[10 Hours]**

DNA Computation Models:
Lipton Model, Sticker model, DNA Splicing model, DNA Self Assembly, Hairpin Model, Algorithms for Natural Security and Cryptography, Experiments in Self-Assembly, DNA Origami (2D and 3D), Error-Correction in Self- Assemble **[10 Hours]**

Bacterial Computers and Data Storage, Peptide Computing, Membrane Computing, Chemical Computing **[10 Hours]**

Outcomes:

By the end of this course, the student must be able to

- Describe the formal models of computation, such as Finite Automata, Push Down Automata and Turing Machine
- Understand the concepts and complexity behind Natural Computing
- Apply the concepts of Natural Processes for DNA, Peptide, Membrane and Chemical Computation

References:

1. Leandro Nunes de Castro,Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, CRC Press, USA, 2006.
2. Zoya Ignatova, Israel Martnez-Prez, and Karl-Heinz Zimmermann, DNA Computing Models, Springer, 2008.
3. Martyn Amos, Theoretical and Experimental DNA Computation, Springer, 2005
4. John E. Hopcroft, Rajeev Motwani, and Jefferey D. Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Asia, 2001.