

Special elective course – S1

Course Name: Introduction to “OMICS” and Systems Analysis (BY516)

L-T-P-C: 3-0-0-3

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Course Number: BY516

Credit: 3-0-0-3

Prerequisites: - IC 136 - Understanding Biotechnology & its Applications **OR** Consent of Faculty member

Students intended for: B. Tech. 3rd and 4th year, MS/MSc. /M. Tech., Ph.D.

Elective or Core: Elective

Semester: Even/Odd

Course Objective:

Genome sequences are now available that enables us to determine the biological components that make up a cell or an organism. These biological components are studied under the fields of OMICS. The new discipline of systems biology examines how these components interact and form networks and how the networks generate whole cell functions corresponding to observable phenotypes. The objective of this course is to first introduce the different OMICS analysis methods including Genomics, Transcriptomics, Epigenomics, Metagenomics, and Metatranscriptomics. The course will further introduce the methods used in systems analysis.

Module 1 [12 Lectures]

Introduction to OMICS

(i) Genomics

- a. High throughput Next-generation sequencing methods
- b. Quality filtering and reads assembly

(ii) Epigenomics

- a. Bisulfite sequencing
- b. ChIP assays

(iii) Transcriptomics

- a. RNA-seq

(iv) Metagenomics and metatranscriptomics

- a. Phylo-typing
- b. Binning

Module 2 [30 lectures]

Methods in Systems Analysis

Basic concepts in systems biology, introduction to Gene Ontology, KEGG and EcoCyc database; Reconstruction of biochemical networks including metabolic networks, transcriptional regulatory networks, and signaling networks; Genome scale modelling, from networks to constraint based models, mathematical representation of reconstructed networks, basic features of Stoichiometric matrix and topological properties analysis; Application of systems analysis to Microbial organisms, analysis of Pathways, Metabolic network properties, Metabolic control analysis, Simulation of cellular activities, Gene dispensability in metabolism.

Text and Reference Books:

- Systems Biology: Properties of Reconstructed Networks, Bernhard O. Palsson, Cambridge University Press, 2006
- A Bioinformatician's Guide to Metagenomics. Victor Kunin et al. MICROBIOLOGY AND MOLECULAR BIOLOGY REVIEWS, Dec. 2008, p. 557–578.
- Next-generation sequencing data interpretation: enhancing reproducibility and accessibility. Anton Nekrutenko & James Taylor *Nature Reviews Genetics* September 2012 Volume 13 No 9 667.
- Oberhardt MA et al. Applications of genome-scale metabolic reconstructions. *Mol Syst Biol* (2009) 5:320
- Francke C *et al.* Reconstructing the metabolic network of a bacterium from its genome. *Trends Microbiol* (2005) 13:550-8