

BI-831 Microarray Analysis -3-0

1. Description: Particular emphasis in 'Microarray Analysis' is placed on the understanding, designing and analysis of different platforms of microarray. This course sheds light on the transcriptomic data analysis of microarrays experiments that have been obtained from different organisms including human beings. As microarray data is composed of thousands of variables that may ultimately pose challenge to the scientist who have to analyze them. In this context, this course will deal with different types of tests, analysis and visualization techniques that may be used in the analysis of different types of microarray platforms. Overall, deep understanding of the microarray architecture and computational analysis will be made available which are required in the fields of biology and medicine.

2. Educational Objectives: Primary focus of the program under which the proposed course will be conducted is

- a. Analysis and interpretation of different platforms of microarray data using R statistical language.
- b. Computational techniques and algorithms designed for the microarray analysis.
- c. Be able to conduct expression microarray data analyses.
- d. Biological interpretation of data.

3. Course Outcomes: After the course the students will be able to apply different concepts of microarray analysis on various practical problems.

4. Detailed Course Contents:

- a. Introduction
 - (1) Overview of Central Dogma of Molecular Biology
 - (2) High density oligonucleotides
 - (3) Spotted complementary cDNA technologies
 - (4) High throughput genomic technologies
- (b) Introduction to microarrays, data analysis and R programming
 - (1) Microarray platforms
 - (2) Affymetrix structure and function
 - (3) File formats
 - (4) Experimental designs
 - (5) Gene ontology (GO) based enrichment analysis
- (c) Overview of statistical techniques and practical application using R and microarray data
 - (1) MA and Volcano Plotting
 - (2) Parametric (Pearson, t-test, one way ANOVA)
 - (3) Non-parametric (Spearman, Wilcoxon)
 - (4) Multiple Comparison/FDR
 - (5) Linear Models
- (d) Data Analysis of leading microarray platforms using Bio-conductor, R and Linux
 - (1) Data pre-processing
 - (2) Background Correction (RMA Calibration of the Data)
 - (3) Normalization (Different Types and their applications in Microarray analysis), log transformation
 - (4) Data manipulation and quality control
 - (5) Principal component analysis
 - (6) Annotation of Transcript Cluster
 - (7) NUSE and RLE plots
 - (8) Summarization
- (e) Meta-analysis in microarray analysis

5. Recommended Text/Reference Books:

- (a) Drăghici, Sorin. Statistics and data analysis for microarrays using R and bioconductor. Chapman and Hall/CRC, 2016.
- (b) Wit, Ernst, and John McClure. Statistics for microarrays: design, analysis and inference. John Wiley & Sons, 2004.
- (c) Zhang, Aidong. Advanced analysis of gene expression microarray data. Vol. 1. World Scientific Publishing Company, 2006.

