1. **Description:** Particular emphasis in ‘Microarray and RNA Sequencing’ is placed on the understanding, designing and analysis of microarray and sequencing experiments. This course sheds light on the high throughput transcriptomic technologies that have been applied to look for a holistic view of the underlying biological mechanisms that occur in response to some stimuli. With the passage of time, scientists have designed a number of tools and algorithms to meet the challenge of analyzing the data generated from these techniques. These technologies have been widely adopted in laboratories around the world. The powerful and flexible nature of these techniques has open gates to many areas of research becoming an indispensable tool for biological research. A deep understanding of the designing of these techniques and analysis of the data generated from them has become a necessity in the field of biology and medicine.

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

   a. Basic understandings on how to analyze and interpret different transcriptomic data using high throughput technologies using R statistical language:
      (1). Understand the analysis of microarray data.
      (2). Understand the analysis of second generation sequencing data at introductory level.
      (3). Read/understand the current literature involving high dimensional Biology. Be able to conduct expression microarray data analyses.
   b. Biological interpretation of data.

**Course Contents:**

3. **Introduction**
   a. Overview of Central Dogma of Molecular Biology
   b. High density oligonucleotides
   c. Spotted complementary cDNA technologies
   d. High throughput genomic technologies

4. **Introduction to microarrays, data analysis and R programming**
   a. Microarray platforms
   b. Affymetrix structure and function
   c. File formats
   d. Experimental designs
   e. Data Analysis using Bio-conductor, R and Linux
      (1) Data pre-processing
         (a) Background Correction
         (b) Normalization, log transformation
      (2) Data manipulation and quality control
         (a) Principal component analysis
         (b) NUSE and RLE plots
      (3) Differential Expression

5. **Overview of statistical techniques and practical application using R and microarray data**
   a. Parametric (Pearson, t-test, one way ANOVA)
   b. Non-parametric (Spearman, Wilcoxon)
   c. Multiple Comparison/FDR

6. **Example analysis**
7. **RNA Sequencing**
   a. Introduction to RNA-seq
   b. RNA seq study design
   c. RNA seq data analysis
      (1) Quality Control
      (2) Alignment
         (a) SNP calling
         (b) Fusion alignments
         (c) Alternative Splicing
      (3) Assembly
         (a) Differential Expression
         (b) Novel Transcriptome
      (4) Example analysis
      (5) RNA seq future

8. **Biological Interpretation**
   a. Bioinformatics functional tools, gene annotation, databases

**Textbooks and Reference books:**

1. DNA Microarray Analysis Using Biocondutor, *JarnoTuimala CSC, the Finnish IT center for Science*
2. Statistics and Data Analysis for Microarrays Using R and Bioconductor*Second Edition
   SorinDraghici*