

**Educational Objectives**

1. The goal of metabolomics is to identify and quantify the complete biochemical composition of a biological sample. With the increase in genomic, transcriptomic and proteomic information there is a growing need to understand the metabolic phenotype that these genes and proteins ultimately control. Metabolomics is becoming an increasingly popular tool in the life sciences since it is a relatively fast and accurate technique that can be applied with either a particular focus or in a global manner to reveal new knowledge about biological systems. There have been many examples of its application to reveal potential biomarkers in different diseases that have employed a range of different analytical platforms. In this course, approaches in metabolomics that have been employed in biomarker discovery will be discussed and some of the most noteworthy research in the field is highlighted. Provides unparalleled options for professional development of students with an interest in metabolism, metabolic disorders, biomarkers discovery and techniques involved in metabolomics.

**Course Outcomes**

2. This course will train graduate students to become proficient and successful investigators who are able to demonstrate a basic knowledge of central concepts in the metabolism, understand the current concepts in metabolomics, current methodologies involved and critically evaluate the scientific literature.

3. **Course Contents**

a. **Introduction**

- (1) Metabolism
- (2) Basics of Metabolic processes
- (3) Metabolic diseases
- (4) Metabolomics
- (5) Comprehensive vs. focused metabolomics

b. **Metabolomics techniques**

- (1) Sample processing
- (2) NMR Analysis
- (3) pH Control
- (4) Extraction of Low-Polarity Metabolites
- (5) Generation of multiple metabolite markers

- c. **Applications of metabolomics**
  - (1) Biomarkers and diagnosis
  - (2) Metabolomics and treatment
  - (3) Cancer metabolomics
  - (4) CVD metabolomics
  - (5) Cross-omics approaches
- d. **Clinical metabolomics**
  - (1) Biomarker identification
  - (2) Imaging Metabolic Biomarkers
  - (3) Metabolomics and Cancer Drug Therapy
  - (4) Metabolic fingerprinting
  - (5) Data mining
  - (6) Metabolic mining
- e. **Mechanisms underlying metabolomic diseases**
  - (1) Tumor-specific blood amino-acid profile
  - (2) Metabolic changes in the tumor-bearing organs
  - (3) Metabolic changes in response to inflammation
  - (4) Metabolic changes in various remote normal organs
- f. **Metabolomic Databases**
  - (1) Human Metabolome Database
  - (2) BiGG database
  - (3) SetupX
  - (4) Systomonas
  - (5) MetaboLights database
  - (6) KEGG, MetaCyc, BioCyc, Reactome

### **Recommended Books**

1. **Metabolome analysis; An Introduction**, Silas G. Vilas Boas, 2006.
2. **Metabolism in Cancer** by Thorsten Cramer, Clemens A. Vol; 207, 2016.
3. **Correlation based network analysis of cancer metabolism, a new systems biology approach in metabolomics** by Emily G. Armitage, Helen L. Kotze, Kaye T. Williams, 2014.
4. **Methodologies for Metabolomics: Experimental Strategies and Techniques** by Norbert W. Lutz, Jonathan V. Sweedler, Ron A. Wevers 1st Edition 2013.