

Molecular Basis of Metabolic Disease (MMD-991)

Credit Hours 3 (3-0)

Course Description

Metabolic disease is the major source of non-infectious morbidity in developed countries, with the incidence of conditions such as obesity-related diabetes projected to increase several-fold over the next few decades. Maintenance of metabolic health requires a detailed understanding of the underlying causes of metabolic disease.

Molecular and cell biological approaches are used within this domain to elucidate the mechanisms involved in the etiology of metabolic disease.

These include:

- Enzymology of metabolic pathways involved in fat metabolism
- Neuronal pathways involved in appetite control and stress
- Membrane-protein structure-function relationships
- Signal transduction mechanisms

These studies focus on mechanisms that enable cells to respond to (patho)physiological conditions encountered throughout life, ranging from conditions in utero, to childhood and to adult life (and connections between them). Cellular stress and sub-clinical inflammation associated with altered metabolic states (e.g. diabetes, obesity, hypertension, polycystic ovary syndrome) are among the research topics covered.

Educational Objective

- The aim of the course is to provide an in-depth understanding of the molecular mechanisms underlying the development of metabolic disorders.
- The course will provide students with the knowledge and training needed to approach and formulate scientific questions relevant to the metabolism.
- The course will also survey the frontiers of metabolism related research and aims to make the students accustomed to the applied advanced methods, technologies and state-of-the-art web-tools used in research related to metabolic flux and its disorders.

Course Outcomes

Having successfully completed this module, the student will be able to:

- Describe the principles of metabolism
- Demonstrate that you have acquired skills in basic biochemical laboratory methods, data interpretation and experimental report writing
- Demonstrate an ability to handle simple mathematical treatments of biological processes.
- Having done this course, you should be very well-prepared for future work on more complex aspects of biochemistry and molecular biology, and confident and equipped for future work on molecular approaches to physiology, pharmacology, cell biology and biotechnology.
- Discuss the role of coenzymes, such as NAD⁺, FAD and ATP, in metabolism;
- Outline the metabolic pathways involved in the catabolism of glucose and fatty acids;
- Show how the energy released by catabolism is recouped by substrate level and oxidative phosphorylation;
- Show how amino acid and carbohydrate metabolism are inter-linked;
- Describe the various types of genetic mutation and inborn errors of metabolism
- Describe the methods for detecting and correcting inborn errors of metabolism
- Outline the hormonal regulation of metabolism and discuss the role of protein phosphorylation in this context;
- Describe the regulation of metabolism in physiological and pathological situations (e.g., exercise, starvation and diabetes)

Course Contents

1. Metabolism
2. Basics of Metabolic processes
3. Metabolic diseases
4. Mechanisms behind metabolic diseases

5. Enzymology of metabolic pathways involved in fat metabolism
6. Neuronal pathways involved in appetite control and stress
7. The metabolic syndrome and causes contributing to its emergency
8. Cardiovascular complications associated with metabolic syndromes
9. Structure and function of the endocrine system and how its regulation affects the internal environment, growth and metabolic control of the body
10. Nutritional approaches for managing metabolic diseases
11. Control and integration of metabolism
12. Application of DNA technology to inborn errors of metabolism
13. Metabolic syndrome: molecular basis and reasons for interaction with obesity
14. Methods for detecting and correcting inborn errors of metabolism
15. Hormonal regulation of metabolism
16. Regulation of metabolism in physiological and pathological situations (e.g., exercise, starvation and diabetes);
17. Inborn errors of metabolism

Recommended Books

1. Cramer, T., & Schmitt, C. A. (Eds.). (2016). *Metabolism in cancer* (Vol. 207). Springer.
2. Das, U. N. (2011). *Molecular basis of health and disease*. Springer Science & Business Media.
3. Chen, Y. T. (2001). The metabolic and molecular bases of inherited disease. *Glycogen storage diseases*, 1521-1551.